

TECHNICAL SPECIFICATIONS

PROJECT: PARKING AREA AND FUEL PUMPS UPGRADE VITRAN BUS DEPOT - PHASE 111
ST. THOMAS, USVI.

PREPARED BY: DPW- ENG. DIVISION
DATE : 1 – 2 - 2017

BID SCHEDULE					
PROPOSED FENCING, PARKING AREA AND FUEL PUMPS UPGRADE					
VITRAN BUSS DEPOT - PHASE III					
PARCELS REM. LOTS NO. 17, 16 & REM. LOT NO.15					
ST. THOMAS, VIRGIN ISLANDS					
				NUMBERS	
No.	DESCRIPTION	UNITS	QTY.	PRICE	TOTAL (\$)
151-01	MOBILIZATION	SF	1.00		
208-01	EXCAVATION (Existing Road)	CY	103.00		
208-03 A	Structural Backfill/Compacted (dirt)	CY	301.00		
208-03 B	Backfill (Sand)	CY	301.00		
208-03-C	Compacted / Backfill (Crusher run 8")	CY	403.00		
401-01	Reinforced portland Cement Concrete pavement (6")	CY	301.00		
401-02	Proposed existing parking concrete pavement	CY	198.00		
635-01	Paved Waterway (Concrete Swale)	SY	65.00		
3300	CAST IN PLACE CONCRETE WORK:				
	A-Footing Excavation (Front Gate and Fence Post)	CY	32.00		
	B-Concrete Footing (Front Gate and Fence Post)	CY	32.00		
619-01	FENCE, GATES, AND CATTLE GUARDS				
	A-Existing Chain Link Fence to be Removed	LF.	800.00		
	B-Remove existing Main Entrance, GATE (35' x 8')	EA	1.00		
	C-Proposed New Cantilever Fence (800 LF X 8')	LF.	800.00		
	D-Proposed New Main Entrance, GATE (36' x 8')	EA	1.00		
	TYPICAL PUMP ISLAND (CONSTRUCTION)				
208-02	A-EXCAVATION : (Canopy Support footing)	CY	1.35		
	B- (Concrete Footing)	CY	2.00		
	C-Concrete Slab (Floor Island)	CY	3.00		
	D- Proposed Steel Columns support (2" O x 20')	EA.	2.00		
	E-Proposed Structural Steel Canopy Roof	SF	1,152.00		
	F-Excavation: (Steel Bollard protection)	CY	1.00		
	G- (Concrete footing)	CY	1.00		
	H- Steel Bollard protection	EA.	4.00		
	FUEL STORAGE TANK: (2"Double wall)				
208-03	A-EXCAVATION: (Fuel storage tank)	CY	31.00		
	B- Slab concrete floor (Concrete Pad)	CY	3.00		
	B'- Cover Slab concrete	CY	3.00		
	C- Installation steel Fuel Storage Tank 15,000 Gallon	EA.	1.00		
	C'-Installation steel Fuel Storage Tank 10,000 Gallon	EA.	1.00		
15400	PLUMBING WORK:	LS	1.00		
16000	ELECTRICAL WORK:	LS	1.00		
	A-Light poles	EA.	3.00		
	B-Wall mounted Light Pole	EA.	1.00		
634-01	PAVEMENT MARKINGS TYPE "H"	LF	600.00		
635-01	TEMPORARY TRAFFIC CONTROL:	LS	1.00		
TOTAL (NUMBERS)					
TOTAL (WORDS):		Dollars and		Cents	
CONTRACTOR'S NAME:					
CONTRACTOR'S SIGNATURE:					

SCOPE OF WORK

This project consists of the developing a scope of work for the Fencing, Parking area & Fuel Pumps Upgrade Vitran Bus Depot Project; located at parcel No. 17,16 & Rem.Lot No.15 in St.Thomas, VI. In this activity the general items of work included but not limited to the following: Improvement Renovation to Vitran Bus Depot to provided exterior general construction work, removal of an existing chain link fence, installation of fuel pumps and pave concrete driveway/parking lot that are approximately 34,750 square feet.

All work must be done in accordance with the Scope of work, Bid Schedule Standard Specifications for Construction of Roads and Bridges on Federal Highway Projects (FP-03), the Manual of Uniform Traffic Control Devices (MUTCD) Part-IV, and recommendation and/or suggestion established by the Project Engineer.

The contractor shall provide and pay for all material, labor, power, transportation, superintendence, temporary construction of any nature, and all other services and facilities of any nature whatsoever necessary to execute, complete and deliver the work within the time stated in the proposal.

Proposed Scope:

The intention of this project is adequately layout to the Vitran Bus Depot facility the program completely.

1. CONTRACTOR'S BID SHALL BE DISQUALIFIED IF ITEMIZED BID SHEET IS NOT FULLY COMPLETED WITH BOTH UNIT AND MATERIAL AND LABOR COSTS FOR ALL ITEMS.
2. THE QUANTITIES NOTED BELOW ARE NOT NECESSARILY EXACT, AND THE ITEMS NOTED DO NOT NECESSARILY MADE UP ALL THE WORK REQUIRED, OR NOTED IN THE CONSTRUCTION DOCUMENTS FOR THE COMPLETE RENOVATION OF THE SPECIAL EDUCATION CLASSROOMS. THE CONTRACTOR SHALL BE RESPONSIBLE FOR SUBMITTING **A TOTAL LUMP SUM COST** FOR THE PROJECT.
3. IT IS THE CONTRACTOR'S RESPONSIBILITY TO ESTABLISH EXACT QUANTITIES BASED ON DOCUMENTS ISSUED AND SITE VISITS CARRIED OUT.
4. PRICES BEEN SUBMITTED FOR WORK TO BE DONE **SHALL INCLUDE THE CONTRACTOR'S OVERHEAD TAXES AND PROFIT** ALONG WITH **ALL COSTS FOR MATERIALS, EQUIPMENT AND MANPOWER** NECESSARY TO FACILITATE PROPER. SAFE, AND TIMELY COMPLETION OF THE PROJECT.
5. UNIT PRICES SUBMITTED ON THE ITEMIZED BID SHEET SHALL BE UTILIZED FOR ANY CREDITS OR DEBITS TO THE PROJECT. WHICH , IF NECESSARY, SHALL BE ADDRESSED AS A CHANGE ORDER TO THE PROJECT.
6. CONTRACTOR SHALL BE FULLY RESPONSIBLE FOR ANY UNDERGROUND UTILITY LINES DAMAGED DURING CONSTRUCTION.

Section 151.- MOBILIZATION

Description

151.01 This work consists of moving personnel, equipment, material, and materials to the project and performing all work necessary before beginning work at the project site. Mobilization includes the obtaining of permits, insurance, and bonds.

Payment will be made under:

Section 151

Pay Item

15101 Mobilization

Pay Unit

Lump sum

Measurement

151.02 Measure mobilization by the lump sum.

Payment

151.03 The accepted quantity, measured as provided above, will be paid at the contract price per unit of measurement for the pay item listed below that is shown in the bid schedule. Payment will be full compensation for the work prescribed in this Section. See Subsection 109.05.

The mobilization lump sum will be paid as follows:

- (a) Bond premiums will be reimbursed according to FAR Clause 52.225. Payment Under Fixed-Price Construction Contracts, after receipt of the evidence of payment.
- (b) 50 percent of the lump sum, not to exceed 5 percent of the original contract amount, will be paid following completion of 5 percent of the original contract amount not including mobilization and bond premiums.
- (c) Payment of the remaining portion of the lump sum, up to 10 percent of the original contract amount, will be paid following completion of 10 percent of the original contract amount not including mobilization and bond premiums.
- (d) Any portion of the lump sum in excess of 10 percent of the original contract amount will be paid after final acceptance.

Section 109

When a weighing device is determined to indicate less than true mass, no additional payment will be made for material previously weighed and recorded. When a weighing device is determined to indicate more than true mass, all material received after the last previously correct weighing accuracy test will be reduced by the percentage of error in excess of 0.5 percent.

109.04 Receiving Procedures. When the method of measurement requires weighing or volume measurement in the hauling vehicle, furnish a person to direct the spreading and distribution of material and to record the location and placement of the material on the project. During the placement, maintain a record of each delivery and document it in an acceptable manner. Include the following information as applicable:

- (a) Project identification
- (b) Contract pay item number and description
- (c) Location where placed
- (d) Date
- (e) Load number
- (f) Truck identification
- (g) Time of arrival
- (h) Mass or volume
- (i) Spread person's signature

Use an approved format for the delivery record(s). Furnish the original record(s) and a written certification of the delivery of the material at the end of each shift.

109.05 Scope of Payment. Payment for all contract work is provided, either directly or indirectly, under the pay items shown in the bid schedule.

(a) **Direct payment.** Payment is provided directly under a pay item shown in the bid schedule when one of the following applies:

- (1) The work is measured in the Measurement Subsection of the Section ordering the work and the bid schedule contains a pay item for the work from the Section ordering the work.

Section 109

(2) The Measurement Subsection of the Section ordering the work references another Section for measuring the work and the bid schedule contains a pay item for the work from the referenced Section.

(b) **Indirect payment.** Work for which direct payment is not provided is a subsidiary obligation of the Contractor. Payment for such work is indirectly included under other pay items shown in the bid schedule. This includes instances when the Section ordering the work references another Section for performing the work and the work is not referenced in the Measurement Subsection of the Section ordering the work.

Compensation provided by the pay items included in the contract bid schedule is full payment for performing all contract work in a complete and acceptable manner. All risk, loss, damage, or expense arising out of the nature or prosecution of the work is included in the compensation provided by the contract pay items.

Work measured and paid for under one pay item will not be paid for under any other pay item.

The quantities shown in the bid schedule are approximate unless designated as a contract quantity. Limit pay quantities to the quantities staked, ordered, or otherwise authorized before performing the work. Payment will be made for the actual quantities of work performed and accepted or material furnished according to the contract. No payment will be made for work performed in excess of that staked, ordered, or otherwise authorized.

109.06 Pricing of Adjustments. Determine all costs according to the contract cost principles and procedures of FAR Part 31. All FAR clauses providing for an equitable price adjustment are supplemented as follows.

If agreement on price cannot be reached, the CO may determine the price unilaterally.

If the work will delay contract completion, request a time extension according to Subsection 108.03.

52.232-5 Payments under Fixed-Price Construction Contracts.

As prescribed in 32.111(a)(5), insert the following clause:

PAYMENTS UNDER FIXED-PRICE CONSTRUCTION CONTRACTS (SEPT 2002)

(a) *Payment of price.* The Government shall pay the Contractor the contract price as provided in this contract.

(b) *Progress payments.* The Government shall make progress payments monthly as the work proceeds, or at more frequent intervals as determined by the Contracting Officer, on estimates of work accomplished which meets the standards of quality established under the contract, as approved by the Contracting Officer.

(1) The Contractor's request for progress payments shall include the following substantiation:

(i) An itemization of the amounts requested, related to the various elements of work required by the contract covered by the payment requested.

(ii) A listing of the amount included for work performed by each subcontractor under the contract.

(iii) A listing of the total amount of each subcontract under the contract.

(iv) A listing of the amounts previously paid to each such subcontractor under the contract.

(v) Additional supporting data in a form and detail required by the Contracting Officer.

(2) In the preparation of estimates, the Contracting Officer may authorize material delivered on the site and preparatory work done to be taken into consideration. Material delivered to the Contractor at locations other than the site also may be taken into consideration if—

(i) Consideration is specifically authorized by this contract; and

(ii) The Contractor furnishes satisfactory evidence that it has acquired title to such material and that the material will be used to perform this contract.

(c) *Contractor certification.* Along with each request for progress payments, the Contractor shall furnish the following certification, or payment shall not be made: (However, if the Contractor elects to delete paragraph (c)(4) from the certification, the certification is still acceptable.)

I hereby certify, to the best of my knowledge and belief, that—

(1) The amounts requested are only for performance in accordance with the specifications, terms, and conditions of the contract;

(2) All payments due to subcontractors and suppliers from previous payments received under the contract have been made, and timely payments will be made from the proceeds of the payment covered by this certification, in accordance with subcontract agreements and the requirements of Chapter 39 of Title 31, United States Code;

(3) This request for progress payments does not include any amounts which the prime contractor intends to withhold or retain from a subcontractor or supplier in accordance with the terms and conditions of the subcontract; and

(4) This certification is not to be construed as final acceptance of a subcontractor's performance.

(Name)

(Title)

(Date)

(d) *Refund of unearned amounts.* If the Contractor, after making a certified request for progress payments, discovers that a portion or all of such request constitutes a payment for performance by the Contractor that fails to conform to the specifications, terms, and conditions of this contract (hereinafter referred to as the "unearned amount"), the Contractor shall—

(1) Notify the Contracting Officer of such performance deficiency; and

(2) Be obligated to pay the Government an amount (computed by the Contracting Officer in the manner provided in paragraph (j) of this clause) equal to interest on the unearned amount from the 8th day after the date of receipt of the unearned amount until—

(i) The date the Contractor notifies the Contracting Officer that the performance deficiency has been corrected; or

(ii) The date the Contractor reduces the amount of any subsequent certified request for progress payments by an amount equal to the unearned amount.

(e) *Retainage.* If the Contracting Officer finds that satisfactory progress was achieved during any period for which a progress payment is to be made, the Contracting Officer shall authorize payment to be made in full.

However, if satisfactory progress has not been made, the Contracting Officer may retain a maximum of 10 percent of the amount of the payment until satisfactory progress is achieved. When the work is substantially complete, the Contracting Officer may retain from previously withheld funds and future progress payments that amount the Contracting Officer considers adequate for protection of the Government and shall release to the Contractor all the remaining withheld funds. Also, on completion and acceptance of each separate building, public work, or other division of the contract, for which the price is stated separately in the contract, payment shall be made for the completed work without retention of a percentage.

(f) *Title, liability, and reservation of rights.* All material and work covered by progress payments made shall, at the time of payment, become the sole property of the Government, but this shall not be construed as—

(1) Relieving the Contractor from the sole responsibility for all material and work upon which payments have been made or the restoration of any damaged work; or

(2) Waiving the right of the Government to require the fulfillment of all of the terms of the contract.

(g) *Reimbursement for bond premiums.* In making these progress payments, the Government shall, upon request, reimburse the Contractor for the amount of premiums paid for performance and payment bonds (including coinsurance and reinsurance agreements, when applicable) after the Contractor has furnished evidence of full payment to the surety. The retainage provisions in paragraph (e) of this clause shall not apply to that portion of progress payments attributable to bond premiums.

(h) *Final payment.* The Government shall pay the amount due the Contractor under this contract after—

(1) Completion and acceptance of all work;

(2) Presentation of a properly executed voucher; and

(3) Presentation of release of all claims against the Government arising by virtue of this contract, other than claims, in stated amounts, that the Contractor has specifically excepted from the operation of the release. A release may also be required of the assignee if the Contractor's claim to amounts payable under this contract has been assigned under the Assignment of Claims Act of 1940 (31 U.S.C. 3727 and 41 U.S.C. 15).

(i) *Limitation because of undefinitized work.* Notwithstanding any provision of this contract, progress payments shall not exceed 80 percent on work accomplished on undefinitized contract actions. A "contract action" is any action resulting in a contract, as defined in FAR Subpart 2.1, including contract modifications for additional supplies or services, but not including contract modifications that are within the scope and under the terms of the contract, such as contract modifications issued pursuant to the Changes clause, or funding and other administrative changes.

(j) *Interest computation on unearned amounts.* In accordance with 31 U.S.C. 3903(c)(1), the amount payable under paragraph (d)(2) of this clause shall be—

(1) Computed at the rate of average bond equivalent rates of 91-day Treasury bills auctioned at the most recent auction of such bills prior to the date the Contractor receives the unearned amount; and

(2) Deducted from the next available payment to the Contractor.

Section 252.- SPECIAL ROCK EMBANKMENT AND
ROCK BUTTRESS

Section 252

Description

252.01 Special rock embankment work consists of furnishing and placing hand-placed or mechanically-placed rock in fill sections. Rock buttress work consists of furnishing and placing hand-placed or mechanically-placed rock in cut sections.

Special rock embankments and rock buttresses are designated as hand-placed or mechanically-placed.

Material

252.02 Conform to the following Subsections:

Rock for buttresses	705.05
Rock for special rock embankment	705.04

Construction Requirements

252.03 Placing Rock. Perform the work under Section 204 or 209 as required.

Place the rock in a stable orientation with minimal voids. Offset the rock to produce a random pattern. Use spalls smaller than the minimum rock size to chock the larger rock solidly in position and to fill voids between the large rock.

Construct the exposed face of the rock mass reasonably uniform with no projections beyond the neat line of the slope that are more than 12 inches for mechanically-placed rock or 6 inches for hand-placed rock.

252.04 Acceptance. Rock for special rock embankment and rock buttress will be evaluated under Subsection 106.02.

Rock placement for special rock embankment and rock buttress will be evaluated under Subsections 106.02 and 106.04.

Structure excavation and backfill will be evaluated under Section 209.

Measurement

252.05 Measure special rock embankment and rock buttress by the cubic yard in place or by the ton.

Payment

252.06 The accepted quantities, measured as provided above, will be paid at the contract price per unit of measurement for the pay items listed below that are shown in the bid schedule. Payment will be full compensation for the work prescribed in this Section. See Subsection 109.05.

Payment will be made under:

Pay Item	Pay Unit
25201 Special rock embankment, _____	Cubic yard
25202 Special rock embankment, _____	Ton
25203 Rock buttress, _____	Cubic yard
25204 Rock buttress, _____	Ton

(b) Non-roadway paving. Compact by rolling with a hand-operated roller weighing at least 300 pounds or with a small power roller.

Compact areas that are not accessible to rollers by other approved methods.

402.08 Pavement Smoothness. Use a 10-foot metal straightedge to measure at right angles and parallel to the centerline. Defective areas are surface deviations in excess of 0.25 inches in 10 feet between any two contacts of the straightedge with the surface. Correct defective areas using approved methods.

402.09 Acceptance. Minor hot asphalt concrete mixture will be evaluated under Subsections 106.02 and 106.03.

Minor hot asphalt concrete construction work will be evaluated under Subsections 106.02 and 106.04. See Table 402-1 for minimum sampling and testing requirements.

Measurement

402.10 Measure asphalt concrete by the ton.

Payment

402.11 The accepted quantities, measured as provided above, will be paid at the contract price per unit of measurement for the pay item listed below that is shown in the bid schedule. Payment will be full compensation for the work prescribed in this Section. See Subsection 109.05.

Payment will be made under:

Pay Item	Pay Unit
40201 Minor hot asphalt concrete	Ton

Table 402-1
Sampling and Testing

Material or Product	Property or Characteristic	Test Methods or Specifications	Frequency	Sampling Point
Roadway paving	Inplace density	Nuclear gauge ⁽¹⁾	1 for each 1200 yd ²	In place after compaction

(1) When directed, verify density by taking core samples from the compacted pavement according AASHTO T 230 method B. Fill and compact the sample holes with asphalt concrete mixture.

SECTION 03300 - CAST-IN-PLACE CONCRETE WORK

PART 1 - GENERAL

1.01 SUMMARY

- A. Provide cast-in-place concrete for general building construction, including, without limitation:
 - 1. Footings, foundations, and basement walls.
 - 2. Basement slab on grade.
 - 4. Base course for exterior pavers.
 - 5. Requirements (materials, mixes, finishes) apply to concrete work specified in other sections, such as sidewalk paving and fill for metal pan stair treads.

1.02 SUBMITTALS

- A. Submit for approval shop drawings, product data, mix design proposed for use, mock-ups, test reports.

1.03 QUALITY ASSURANCE

- A. Comply with governing codes and regulations. Provide products of acceptable manufacturers which have been in satisfactory use in similar service for three years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions.
- B. Testing: Employ an independent testing agency acceptable to Owner to design concrete mixes and to perform material evaluation tests. Provide 7 and 28 day cylinder tests. Comply with ASTM C143, C173, C31 and C39.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Formwork: APA rated B-B Plyform forms sufficient for structural and visual requirements or approved equal.
- B. Reinforcement:
 - 1. Bars: Deformed steel, ASTM A 615, Grade 60.
 - 2. Mesh: Welded steel wire fabric, ASTM A 185.
- C. Concrete materials:
 - 1. Cement: Portland cement, ASTM C 150, Type 1.
 - 2. Aggregate: Normalweight aggregates, ASTM C 33.
- D. Admixtures, all with less than 1% chloride ions:

1. Water-reducing type and superplasticizer as required for workability; Euclid, Sika, L&M or approved equal.
2. Air-entraining type for use in exterior concrete and foundations exposed to freeze-thaw; Euclid, Sika, L&M or approved equal.

E. Miscellaneous Materials:

1. Vapor barrier under slab on grade: 6 mil polyethylene.
2. Hardener: Non-metallic, quartz-silica, interior/exterior type; Euclid Surflex or approved equal.
3. Grout: Non-metallic, non-shrink type.
4. Waterstops: Dumbbell shaped, rubber or PVC waterstops.
5. Non-slip finish: Aluminum oxide grit.

F. Concrete Mixes:

1. 4000 psi for piers and foundation walls.
3. 3000 psi for paving and paving base.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Comply with ACI 301, 304, 305, 306, 311, 318, 347, CRSI "Manual of Standard Practice", and ASTM C94. Do not change mix design without approval. Calcium chloride admixtures are not permitted.
- B. Chamfer exposed edges/corners to provide straight lines.
- C. Tolerance: Plus 1/8" in 10' for grade, alignment, and straightness.
- D. Construction Joints: Use keyways, continue reinforcement through joint.
- E. Expansion Joints: For exterior work locate 30' o.c. at approved locations. Provide smooth dowels across joint which permit 1" horizontal movement and no vertical shear movement.
- F. Isolation Joints: Provide between slabs and vertical elements such as columns and structural walls.
- G. Control Joints: Provide sawn or tooled joints or removeable insert strips; depth equal to 1/4 slab thickness. Spacing as required and approved.

H. Wall Finishes: As-cast and patched for concealed work; rubbed smooth, filled and cement paste coated for exposed work.

I. Slab Finishes: Obtain sample approval before beginning work.

1. Scratch: For surfaces to receive mortar setting beds or cementitious flooring materials.
2. Trowel: Hard, smooth, uniform surface for areas to receive resilient flooring, carpet, or other thin finish material.
3. Broom: After trowel finishing, roughen surface by fine brooming perpendicular to traffic direction for exposed exterior walks, steps and ramps.
4. Non-Slip Aggregate: After trowel finishing, uniformly trowel 25 lbs/100 s.f. of damp non-slip aggregate into surface. Cure, then rub lightly to expose aggregate. Use for interior exposed concrete stairs and ramps.
5. Exposed Aggregate: Use chemical retarder or tamp aggregate into wet concrete and expose by brushing with water. Use where indicated.
6. Hardener Finish: For exposed interior concrete floors. Follow manufacturer's directions.

J. Cure and protect work. Report defective work in writing.

END OF SECTION

Description

308.01 This work consists of furnishing and placing crushed aggregate for bedding, backfill, and roadway aggregate courses.

The roadway aggregate compaction method is designated as shown in Subsection 308.05(a).

Material

308.02 Conform to the following Subsections:

Crushed aggregate	703.06
Water	725.01

Construction Requirements

308.03 Preparing Surface.

(a) **Roadway aggregate.** Prepare the surface on which the aggregate course is placed according to Subsection 303.07.

(b) **Bedding and backfill aggregate.** Shape, compact, and finish the surface to the required lines, grade, elevation, and cross-section according to Section 209.

308.04 Placing Crushed Aggregate.

(a) **Roadway aggregate.** Mix the aggregate and adjust the moisture content to obtain a uniform mixture with a moisture content suitable for compaction. Spread and shape the mixture on the prepared surface in a uniform layer.

Do not place the mixture in a layer exceeding 6 inches in compacted thickness. When more than one layer is necessary, compact each layer according to Subsection 308.05(a) before placing the next layer.

(b) **Bedding and backfill aggregate.** Place and shape the mixture in layers that when compacted do not exceed 6 inches in depth.

308.05 Compacting and Finishing Crushed Aggregate.

(a) **Roadway aggregate.** Compact using the specified method. When no method is specified, use either method. Finish the surface according to Subsection 301.06.

(1) **Method 1.** Compact each layer according to Subsection 204.11(a). Roll from the sides to the center, parallel to the centerline of the road. Along curbs, headers, and walls, and all places not accessible to the roller, compact the material with approved tampers or compactors.

Compactive effort may be decreased if inplace densities show that less compactive effort is required under method 2.

(2) **Method 2.** Compact each layer according to 301.05.

(b) **Bedding and backfill aggregate.** Compact each layer according to Subsection 209.11.

308.06 Acceptance. Crushed aggregate will be evaluated under Subsections 106.02 and 106.03. Furnish a production certification including gradation and quality properties for each source.

Construction of roadway aggregate courses will be evaluated under Subsections 106.02 and 106.04. Method 2 compaction will be evaluated under Section 106.04. See Table 308-1 for sampling and testing requirements.

Placement of bedding and backfill aggregate will be evaluated under Subsection 106.02 and Section 209.

Preparation of the surfaces on which crushed aggregate is placed will be evaluated under Section 303 and 209 as applicable.

Measurement

308.07 Measure crushed aggregate by the cubic yard in the hauling vehicle, by the ton, or by the square yard.

Payment

Payment will be made under:

401.19 The accepted quantities, measured as provided above, will be paid at the contract price per unit of measurement for the pay items listed below that are shown in the bid schedule except the hot asphalt concrete pavement contract unit bid price will be adjusted according to Subsection 106.05. Payment will be full compensation for the work prescribed in this Section. See Subsection 109.05.

Payment for hot asphalt concrete pavement will be made at a price determined by multiplying the contract unit bid price by the material pay factor. The material pay factor is the lowest single pay factor determined for asphalt concrete specific gravity (density), or any individual sieve of the aggregate gradation

When the bid schedule contains a pay item for hot asphalt concrete pavement type I, II, or III pavement smoothness, a separate adjustment will be made for pavement smoothness according to the following formula:

$$A = 20.000(PF - 1.00)(L)$$

Where:

- A = Adjustment to contract payment in dollars for pavement smoothness
- L = Total project length in lane miles of traveled way. Measure project length to 3 decimal places.
- PF = Pay factor for smoothness with respect to the upper specification limit determined according to Subsection 106.05 after completion of corrective work.

Pay Item	Pay Unit
40101 Hot asphalt concrete pavement class ___, grading ___, type ___ pavement smoothness	Ton
40102 Hot asphalt concrete pavement class ___, grading ___, wedge and leveling course	Ton
40103 Asphalt cement grade ___	Ton
40104 Mineral filler	Ton
40105 Antistripping additive type ___	Ton
40106 Superpave asphalt concrete pavement, nominal maximum size aggregate, ___ ESALs, type ___ pavement smoothness	Ton

Payment

308.08 The accepted quantities, measured as provided above, will be paid at the contract price per unit of measurement for the pay item listed below that is shown in the bid schedule. Payment will be full compensation for the work prescribed in this Section. See Subsection 109.05.

Payment will be made under:

Pay Item	Pay Unit
0801 Roadway aggregate method _____	Cubic yard
0802 Roadway aggregate method _____	Ton
0803 Roadway aggregate method _____	Square yard
0804 Bedding and backfill aggregate	Cubic yard
0805 Bedding and backfill aggregate	Ton
0806 Bedding and backfill aggregate	Square yard

Table 308-1
Sampling and Testing

Material or Product	Property or Characteristic	Test Methods or Specifications	Frequency	Sampling Point
Crushed aggregate ⁽¹⁾	Moisture-Density	AASHTO T 180 method D	1 for each aggregate supplied	Production output or stockpile.
	Inplace density and moisture content	AASHTO T 238 and AASHTO T 239 or other approved procedures	1 for each 500 tons	Inplace completed compacted layer

(1) Sampling and testing required for roadway aggregate method 2.

Section 401 HOT ASPHALT CONCRETE PAVEMENT

Section 401

Description

401.01 This work consists of constructing one or more courses of hot asphalt concrete pavement.

Hot asphalt concrete pavement class is designated as shown in Table 401-1. Aggregate grading is designated as shown in Table 703-4. Smoothness type is designated as shown in Table 401-7.

Suppave asphalt concrete pavement ESALs is designated as shown in Tables 703-10 through 703-13. Nominal maximum size aggregate is designated as shown in Tables 703-14 through 703-16. Smoothness type is designated as shown in Table 401-7.

Asphalt cement grade is designated as shown in AASHTO M 20, AASHTO M 220, or AASHTO M 11.

Antistripping additive is designated as shown in Subsection 702.08. Where no type is designated, use any type if needed.

Material

401.02 Conform to the following Subsections:

Aggregate (Classes A, B, or C mix)	703.07
Aggregate (Suppave mix)	703.17
Antistripping additive	702.08
Asphalt cement	702.01
Mineral filler	725.05

Construction Requirements

401.03 Composition of Mix (Job-Mix Formula). For all but the final surface course, recycled material may be used according to Section 403. Recycled material may be used in the final surface course subject to approval of a Contractor quality control plan and submission of test data demonstrating that the mix will meet the requirements of this Section.

Furnish mixes as follows:

- Class A, B, or C mix. Furnish aggregate, asphalt, and additives that meet the applicable aggregate gradation in Table 703-4 and design parameters (a) or (b); (c) or (d); and (e) in Table 401-1.

Table 401-1
Asphalt Concrete Mix Requirements

Design Parameters ^(a)	Class of Mix		
	A	B	C
(a) Hveem (AASHTO T 246 and AASHTO T 247)			
(1) Stabliometer, minimum	37	35	30
(2) Percent air voids ^(b)	3-5	3-5	3-5
(3) Voids in mineral aggregate, min. %	See Table 401-2		
(b) Marshall (AASHTO T 245)			
(1) Stability, lbs min.	1,800	1,200	1,000
(2) Flow, 0.01 in	8-16	8-18	8-20
(3) Percent air voids ^(b)	3-5	3-5	3-5
(4) Voids in mineral aggregate, min. %	See Table 401-2		
(5) Compaction, number of blows each end of test specimen	75	50	50
(c) Immersion - Compression (AASHTO T 165 and AASHTO T 167)			
(1) Compressive strength, min. psi	300	250	200
(2) Retained strength, min. %	70	70	70
(d) Root-Tunncliffe (ASTM D 4867)			
(1) Tensile strength ratio, min. %	70	70	70
(e) Dust-asphalt ratio ^(c)	0.6-1.3	0.6-1.3	0.6-1.3

^(a) The percent of air voids are based on AASHTO T 166, AASHTO T 209, AASHTO T 269. Minimum specific gravity (density) will be based on AASHTO T 209.

^(b) Dust-asphalt ratio is defined as the percent of material including nonliquid antistripping and mineral filler passing the No. 200 sieve divided by the percent of asphalt (calculated by mass mix).

Table 401-2
Voids in Mineral Aggregate (VMA)
Marshall, Hveem, or Superpave Mix Design

Sieve Size (a)	Minimum Voids (a)(b)		
	Marshall	Hveem	Superpave
No. 8	21	19	-
No. 4	18	16	-
3/8 inch	16	14	15
1/2 inch	15	13	14
3/4 inch	14	12	13
1 inch	13	11	12
1 1/2 inch	12	10	11
2 inch	11.5	9.5	10.5

- (1) The largest sieve size listed in the applicable specification upon which any material is permitted to be retained.
- (2) VMA to be determined according to *AI Manual Series No. 2 (MS-2)*.
- (3) When a mineral filler or nonliquid antistriper is used, include the percentages specified in the calculation for compliance with the VMA.

- Superpave level 1 mix. Furnish mixes of aggregate, asphalt, and additives that meet applicable gradation and material requirements in Subsections 703.17 and the appropriate design parameters in Tables 401-2, 401-3, and 401-4. Compact specimens with the gyratory compactive effort specified in Table 401-5 for the corresponding traffic and air temperature.

Table 401-3
Superpave Asphalt Concrete Mix Requirements

Design Parameters	Requirement
Percent air voids at design gyrations, N_{des}	4.0
Percent maximum density at initial gyrations, N_{rel}	89% maximum
Percent maximum density at maximum gyrations, N_{max}	98% maximum
Tensile strength ratio, min (AASHTO T 283)	80
Dust-asphalt ratio ⁽¹⁾	0.6-1.2

- (1) Dust-asphalt ratio is defined as the percent of material passing the No. 200 sieve divided by the effective asphalt content as calculated by mass of mix.

Table 401-4
Superpave Voids Filled with Asphalt (VFA)

Traffic, million ESALs	Design VFA, %
≤ 0.3	70 - 80
> 0.3 - 3	65 - 78
> 3	65 - 75

Table 401-5
Gyratory Compactive Effort

Design ESAL's millions	Average Design High Air Temperature											
	<102°F			102-104°F			105-108°F			109-111°F		
	N _{10ft}	N _{den}	N _{max}	N _{10ft}	N _{den}	N _{max}	N _{10ft}	N _{den}	N _{max}	N _{10ft}	N _{den}	N _{max}
< 0.3	7	68	104	7	74	114	7	78	121	7	82	127
> 0.3 - 1	7	76	117	7	83	129	7	88	138	8	93	146
> 1 - 3	7	86	134	8	95	150	8	100	158	8	105	167
> 3 - 10	8	96	152	8	106	169	8	113	181	9	119	192
> 10 - 30	8	109	174	9	121	195	9	128	208	9	135	220
> 30 - 100	9	126	204	9	139	228	9	146	240	10	153	253
> 100	9	142	233	10	158	262	10	165	275	10	172	288

Submit written job-mix formulas for approval at least 21 days before production. For each job-mix formula, submit the following:

(a) Aggregate and mineral filler.

(1) Target value for percent passing each sieve size for the aggregate blend. Designate target values within the gradation band in the specified grading. Designate target values outside the restricted zone of Table 703-14, 703-15, or 703-16 for the appropriate nominal maximum size aggregate.

(2) Source and percentage of each aggregate stockpile to be used.

(3) Average gradation of each aggregate stockpile.

(4) Representative samples for each aggregate stockpile:

- (a) 250 pounds of each coarse aggregate
- (b) 150 pounds of each intermediate and fine aggregate
- (c) 20 pounds of mineral filler such as lime stone or filler earth if proposed to improve gradation characteristics or mix performance.
- (d) 20 pounds of bag house fines if proposed for the mix. See Subsection 401.04.

Aggregate samples when combined according to the Contractor's recommended stockpile percentages shall be within the gradation band defined by the target values plus or minus the allowable deviation for each sieve or the samples will not be considered representative.

(5) Results of aggregate quality tests.

(b) Asphalt cement.

(1) Five 1-gallon samples of the asphalt cement to be used in the mix.

(2) Recent quality test results from the manufacturer for the asphalt cement including a temperature-viscosity curve.

(3) Material safety data sheets.

(c) Antistripping additives. When an antistripping additive is needed to meet the

mix requirements, furnish the following:

- (1) Sample
 - (a) 1 pint of liquid heat-stable antistripping additive or
 - (b) 10 pounds of dry antistripping additive such as lime or portland cement
- (2) Name of product
- (3) Manufacturer
- (4) Material safety data sheet

(d) Asphalt mixes. When applicable, the location of all commercial mixing plants to be used. A job-mix formula is needed for each plant.

The CO will evaluate the suitability of the material and the proposed job-mix formula. If approved, the CO will develop a target value for the asphalt-cement content, determine the need for antistripping additive, determine the maximum specific gravity (density) according to AASHTO T 209, and determine the discharge temperature range.

If a job-mix formula is rejected, submit a new job-mix formula as described above.

Changes to an approved job-mix formula require approval before production. Up to 14 days will be required to evaluate a change. Approved changes in target values will not be applied retroactively for payment.

The CO will deduct all job-mix formula evaluation costs incurred as a result of any of the following:

- Contractor-requested changes to the approved job-mix formula
- Contractor requests for additional job-mix formula evaluations
- Additional testing necessary due to the failure of a submitted job-mix formula

401.04 Mixing Plant. Use mixing plants conforming to AASHTO M 156 supplemented as follows:

(a) All plants.

(1) Automated controls. Control the proportioning, mixing, and discharging of the mix automatically.

(2) Dust collector. AASHTO M 156, Requirements for All Plants, Emission Controls is amended as follows:

Equip the plant with a dust collector. Dispose of the collected material. In the case of baghouse dust collectors, dispose of the collected material or return the collected material uniformly. Use of baghouse fines in asphalt concrete mixes requires approval unless included as part of the approved job-mix formula.

When baghouse fines are used in batch plants or continuous mix plants, deposit the material that is returned from the baghouse at the bottom of the hot elevator or meter it by volume or mass into the mixing chamber. Direct return from the baghouse to the hot elevator will be permitted only when the flow can be controlled at a uniform rate. In drum dryer-mixer plants, return the material to the drum at the same location as the asphalt.

(3) Aggregate storage. Store aggregate according to Section 307.

(b) Drum dryer-mixer plants.

(1) Bins. Provide a separate bin in the cold aggregate feeder for each individual aggregate stockpile in the mix. Use bins of sufficient size to keep the plant in continuous operation and of proper design to prevent overflow of material from one bin to another.

(2) Stockpiling procedures. Separate aggregate into at least 2 stockpiles with different gradations. As a minimum, one stockpile shall contain mostly coarse material, and one stockpile shall contain mostly fine material. Stockpile the material according to Section 307.

(c) Batch and continuous mix plants.

(1) Hot aggregate bin. Provide a bin with 3 or more separate compartments for storage of the screened aggregate fractions to be combined for the mix. Make the partitions between the compartments tight and of sufficient height to prevent spillage of aggregate from one compartment into another.

(2) Load cells. Calibrated load cells may be used in batch plants instead of scales.

401.05 Pavers. Use pavers that are:

(a) Self-contained, power-propelled units with adjustable vibratory screeds and full-width screw augers.

(b) Heated for the full width of the screed.

(c) Capable of spreading and finishing courses of asphalt mix in widths at least 12 inches more than the width of one lane.

(d) Equipped with a receiving hopper having sufficient capacity to ensure a uniform spreading operation.

(e) Equipped with automatic feed controls, which are properly adjusted to maintain a uniform depth of material ahead of the screed.

(f) Operable at forward speeds consistent with satisfactory mix lay down.

(g) Capable of producing a finished surface of the required smoothness and texture without segregating, tearing, shoving, or gouging the mix.

(h) Equipped with automatic screed controls with sensors capable of sensing grade from an outside reference line, sensing the transverse slope of the screed, and providing the automatic signals that operate the screed to maintain grade and transverse slope.

401.06 Surface Preparation. Prepare the surface according to 303.07, 413, 502, or 503 as applicable. Apply an asphalt tack coat to contact surfaces of pavements, curbs, gutters, manholes, and other structures according to Section 412.

401.07 Weather Limitations. Place hot asphalt concrete pavement on a dry, unfrozen surface when the air temperature in the shade is above 35 °F and rising and the temperature of the road surface in the shade conforms to Table 401-6.

Table 401-6
Asphalt Concrete Mix Placement Temperature

Compacted Lift Thickness ⁽¹⁾ Road Surface Temperature ⁽²⁾ F	< 2 in	2 1/2 in	> 3 in
< 35	(a)	(a)	(a)
35 - 39.9	(a)	(a)	280
40 - 49.9	(a)	285	275
50 - 59.9	295	280	270
60 - 69.9	285	275	265
70 - 79.9	280	270	265
80 - 89.9	270	265	260
≥ 90	265	260	255

(1) In no case shall the asphalt concrete mix be heated above the temperature specified in the approved mix design.

(2) Paving not allowed.

401.08 Asphalt Preparation. Uniformly heat the asphalt cement to provide a continuous supply of the heated asphalt cement from storage to the mixer. Do not heat asphalt cement above 350 °F.

If the job-mix formula requires a liquid heat stable antistripping additive, meter it into the asphalt cement transfer lines at a bulk terminal or mixing plant. Inject the additive for at least 80 percent of the transfer or mixing time to obtain uniformity.

401.09 Aggregate Preparation. If nonliquid antistriper is used, adjust the aggregate moisture to at least 4 percent by mass of aggregate. Mix the antistriper uniformly with the aggregate before introducing the aggregate into the driver or driver drum. Use calibrated weighing or metering devices to measure the amount of antistriper and moisture added to the aggregate.

For batch plants, heat, dry, and deliver aggregate for pugmill mixing at a temperature sufficient to produce a mix temperature within the approved range. Adjust flames used for drying and heating to prevent damage to and contamination of the aggregate.

Control plant operations so the moisture content of the mix behind the paver is 0.5 percent or less according to AASHTO T 110 or FLH T 515.

401.10 Mixing. Measure the aggregate and asphalt into the mixer according to the approved job-mix formula. Mix until all the particles are completely, and uniformly coated with asphalt according to AASHTO M 156. Maintain the discharge temperature within the approved range.

401.11 Hauling. Use vehicles with tight, clean, and smooth metal beds for hauling asphalt concrete mixes.

Thick coat the beds with an approved material to prevent the mix from adhering to the beds. Do not use petroleum derivatives or other coating material which contaminate or alter the characteristics of the mix. Drain the bed before loading.

Equip each truck with a canvas cover or other suitable material of sufficient size to protect the mix from the weather. When necessary to maintain temperature, use insulated truck beds and securely fastened covers. Provide access ports or holes for checking temperature of asphalt mix in the truck.

401.12 Production Start-Up Procedures. Provide 7 days notice before beginning production of an asphalt concrete mix.

On the first day of production, produce sufficient mix to construct a 1000-foot long control strip, one-lane wide, and at the designated lift thickness. Construct the control strip on the project at an approved location.

Construct the control strip using mix production, lay-down, and compaction procedures intended for the entire mix. Cease production after construction of the control strip until the asphalt concrete mix and the control strip are evaluated and accepted.

(a) **Asphalt content and aggregate gradation.** Take at least three control strip asphalt concrete mix samples and evaluate according to Subsection 401.17. The mix is acceptable if all test results are within specification limits for asphalt content and aggregate gradation.

(b) **Compaction.** Take nuclear density readings behind each roller pass to determine the roller pattern necessary to achieve required density without damaging the mix.

At a minimum of 4 locations within the control strip, take nuclear gauge readings and cut and test core samples according to Subsection 401.17. Density is acceptable if all tests are above the specification limit. Furnish the CO with the nuclear gauge readings and correlations of the readings to the core specific gravities.

Repeat the control strip process until an acceptable control strip is produced. See Subsection 106.01 for the disposition of material in unacceptable control strips. Accepted control strips may remain in place and will be accepted and measured as a part of the completed pavement. Tests used for the control strip will not be included in the evaluation for payment according to Subsection 106.05. When a control strip is accepted, full production may begin.

Use these start-up procedures when producing material from a different plant or when resuming production after a termination of production due to unsatisfactory quality according to Subsection 106.05.

401.13 Placing and Finishing. Do not use mixes produced from different plants unless the mixes are produced according to the same job-mix formula, use material from the same sources, and are approved. Construct control strips according to Subsection 401.12 for each plant from which production is intended.

Place asphalt concrete mix at a temperature conforming to Table 401-6. Measure temperature of the mix in the hauling vehicle just before dumping into spreader or measure it in the windrow immediately before pickup.

Place the mix with a paver conforming to Subsection 401.05. Control horizontal alignment using a reference line. Automatically control the grade and slope from reference lines, a ski and slope control device, or dual skis. Use skis having a minimum length of 20 feet.

In areas where mechanical spreading and finishing is impractical, place and finish the mix with alternate equipment to produce a uniform surface closely matching the surface obtained when using a mechanical paver.

Offset the longitudinal joint of one layer at least 6 inches from the joint in the layer immediately below. Make the longitudinal joint in the top layer along the centerline of two-lane roadways or at the lane lines of roadways with more than two lanes.

The CO will designate the job-mix formula to be used for wedge and leveling courses at each location. Place wedge and leveling courses in maximum 3-math lifts. Complete the wedge and leveling before starting normal paving operations.

401.14 Compacting. Furnish at least 3 rollers. Furnish one roller each for breakdown, intermediate, and finish rolling. At least one roller shall be accurately tied. Size the rollers to achieve the required results. Operate rollers according to the recommendation of the manufacturer.

Thoroughly and uniformly compact the asphalt surface by rolling. Do not cause undue displacement, cracking, or shoving. Continue rolling until all roller marks are eliminated and the required density is obtained. Do not roll the mix after the surface cools below 175 °F.

Monitor the compaction process with nuclear density gauges calibrated to the control strip compaction test results. Compact to a pavement specific gravity (density) that is no less than 90 percent of the maximum specific gravity (density) determined according to AASHTO T 209.

Along forms, curbs, headers, walls, and other places not accessible to the rollers, compact the mix with alternate equipment to obtain the required compaction.

401.15 Joints, Trimming Edges, and Cleanup. Complete construction of adjacent traffic lanes to the same elevation within 24 hours. If drop offs are left overnight, sign the drop offs in excess of 2 inches with "Uneven Lane" warning signs and provide a 3:1 fillet for drop offs in excess of 4 inches.

At connections to existing pavements and previously placed lifts, make the transverse joints vertical to the depth of the new pavement. Form transverse joints by cutting back on previous run to expose the full-depth course.

Apply an asphalt tack coat to the edge of the joint for both transverse and longitudinal joints according to Section 412.

Place the asphalt concrete mix as continuously as possible. Do not pass rollers over the unprotected end of a freshly laid mix.

Dispose of material trimmed from the edges and any other discarded asphalt mix according to Subsection 211.03(b).

401.16 Pavement Smoothness. After final rolling, measure the smoothness of the final surface course or the surface immediately under an open-graded asphalt friction course.

(a) **Profilograph measurements.** Measure the traveled way parallel to the centerline according to FLH T 504 after mainline paving is completed. The CO will furnish a California type profilograph and direct and observe its operation. Furnish workers to operate the profilograph. Furnish the trace to the CO.

Exclude the following areas from the profile index and profilograph bump determination: bridge decks, cattle guards, traveled way lanes with horizontal curvature less than 500-foot radius, transverse joints with existing pavements, turning or passing lanes less than 350 feet in length, driveways, parking areas, and side roads less than 350 feet in length. Measure excluded areas and type IV pavements according to (b) below.

A profile index will be calculated for each 0.1 mile lane of traveled way using a 0.2-inch wide blanking-band. The profile index will be determined according to FHWA T 504. Bumps will be located using a 0.4-inch bump template. Defective areas are bumps in excess of 0.4 inches in 25 feet, (c) 1-mile profile indexes greater than the defective limit in Table 401-7, and surfaces with a pay factor less than 0.75 as determined under Subsection 106.05

(b) Straightedge measurement. Use a 10-foot metal straightedge to measure at right angles and parallel to the centerline. Defective areas are surface deviations in excess of 0.2 inches in 10 feet between any two contacts of the straightedge with the surface.

(c) Defective area correction. Correct defective areas from (a) and (b) above. Obtain approval for the proposed method of correction.

Recompute corrected areas according to (a) and (b) above. The smoothness pay factor will be recomputed after measurement.

Table 401-7

Maximum Profile Index

Pavement Smoothness Type	Profile Index—inches/mile	
	Upper Specification Limit	Defective Limit
I	5	10
II	8	12
III	10	15
IV	Subject to straightedge measurement only. See Subsection 401.16(b).	

401.17 Acceptance. Mineral filler and antistripping additive will be evaluated under Subsections 106.02 and 106.03.

Asphalt will be evaluated under Subsections 106.04 and 702.09.

Construction of the hot asphalt concrete pavement course will be evaluated under Subsections 106.02 and 106.04.

Asphalt content, aggregate gradation, density, and pavement smoothness will be evaluated under Subsection 106.05. Other aggregate quality properties will be evaluated under Subsections 106.02 and 106.04. See Table 401-8 for minimum sampling and testing requirements.

(a) Asphalt content. The upper and lower specification limits are the approved job-mix formula target value ± 0.5 percent. See Table 401-8 for the acceptance quality characteristic category.

(b) Aggregate gradation. The upper and lower specification limits are the approved job-mix formula target values plus or minus the allowable deviations shown in Table 703-4. See Table 401-8 for the acceptance quality characteristic categories.

(c) Density. The lower specification limit is 90 percent of the maximum specific gravity (density) determined according to AASHTO T 209 as part of the job-mix formula evaluation specified in Subsection 401.03. See Table 401-8 for the acceptance quality characteristic category.

(d) Pavement smoothness. See Subsection 401.16. The evaluation will be made after all defective areas are corrected. A subplot is a 0.1-mile section of the traveled way and a lot is the surface course of the entire project. The upper specification limit is shown in Table 401-7. See Table 401-8 for the acceptance quality characteristic category.

Measurement

401.18 Measure hot asphalt concrete pavement, asphalt cement, mineral filler, and antistripping additive by the ton.

Description

19.01 This work consists of constructing fences, gates, cattle guards, and ollard posts and removing and resetting fence.

Material

19.02 Conform to the following Sections and Subsections:

Barbed wire	710.01
Chain link fence	710.03
Concrete	601
Fence gates	710.05
Fence posts and bollards	710.04
GROUT	725.22(e)
Precast concrete units	725.11
Reinforcing steel	709.01
Temporary plastic fence	710.11
Woven wire	710.02

Construction Requirements

19.03 Fences and Gates.

(a) **General.** Clear along the fence line. Remove and dispose of trees, brush, logs, upturned stumps, roots of downed trees, rubbish, and debris according to Subsection 201.06. Clear a 10-foot width for chain link fence and a 3-foot width for wire fence.

Grubbing is not required except where short and abrupt changes in the ground contour require removal of stumps to properly grade the fence line. Remove or close cut stumps within the clearing limits.

Perform clearing and leveling with minimum disturbance to the terrain outside the fence line.

Schedule the fence installation, provide temporary fence, or other adequate means to prevent livestock from entering the project right-of-way, easements, or adjoining properties.

At bridges, cattle underpasses, and culverts, connect new fence to structure to permit free passage of livestock under or through the structure.

(b) Chain link fence and gates.

(1) **Posts.** Space posts at not more than 10-foot intervals. Measure the post spacing interval horizontally. Set posts vertically.

Set posts in concrete according to Section 601.

Where solid rock is encountered without overburden, drill line post holes at least 14 inches deep and drill end, corner, gate, and pull posts at least 20 inches deep in the solid rock. Make the hole width or diameter at least 1 inch greater than the post width or diameter. Cut the post to the required length before installation or drill the hole deep enough to set the post at the required height. Set and plumb the post and fill the hole with grout. Thoroughly work the grout into the hole to eliminate voids. Crown the grout to drain water away from the post.

Where solid rock is covered with soil or loose rock overburden, set posts to the plan depth or to the minimum depth into the solid rock as specified above, whichever is less. When solid rock is encountered before the plan depth, grout the portion of the post in solid rock and backfill the post hole from the solid rock to the top of the ground with concrete.

Provide end, gate, corner, and pull posts with adjacent brace posts as shown on the plans. A change in the fence alignment of 20 degrees or more is considered a corner.

(2) **Top rail.** Install top rails through the ornamental tops of the line posts, forming a continuous brace from end-to-end of each stretch of fence. Join lengths of top rail with sleeve-type couplings. Securely fasten top rails to terminal posts by pressed steel fittings or other appropriate means.

Install corner posts at changes in alignment of 30 degrees or more. Where new fence joins an existing fence, set end or corner posts, as necessary, and attach in a manner satisfactory to the CO.

(2) **Braces.** Limit fence runs to no more than 650 feet between adjacent corner braces, gate braces, end braces, or line braces. Install line braces at uniform intervals so the distance between any two braces is 650 feet or less. Construct braces before placing the fence fabric and wires on posts.

(a) *Metal braces.* Provide corner posts and pull posts with two braces, one each direction from the post in the main fence line. Provide end posts and gate posts with one brace in the line of the fence. Attach metal braces to the metal end, corner, pull, and gate posts and set in concrete as shown.

(b) *Wood braces.* Tap the posts to receive the braces. Anchor the brace to the post with three 16d nails or a 0.4- by 4 inch dowel. Install brace wires as shown and twist together until the entire assembly is taut and firm. Lightly notch the posts to position the brace wire. Drive three staples at each notch to secure wire.

(3) **Barbed wire and woven wire.** Place barbed wire and woven wire on the post face away from the highway. On curved alignment, place the barbed wire and the woven wire on the post face on the outside of the curve. Tightly stretch and fasten barbed wire and woven wire to the posts.

Apply tens on according to the manufacturer's recommendations using a mechanical stretcher or other device designed for such use. Evenly distribute the pull over the longitudinal wires in the woven wire so not more than 50 percent of the original depth of the tension curves is removed. Do not use a motor vehicle to stretch the wire.

Splicing of barbed wire and woven wire between posts is permitted provided not more than two splices, spaced a minimum of 50 feet apart, occur in any one run of fence. Use wrap or telephone type splices for the longitudinal woven wire and barbed wire with each end wrapped around the other wire for not less than six complete turns.

(4) **Fastening barbed wire and woven wire.** Terminate the woven wire and barbed wire at each end, corner, gate, and pull post. Warp each line of barbed wire and each longitudinal wire of the woven wire around the post and then itself with at least four turns. Where wood posts are used, staple the wires tightly to the posts.

At line posts, fasten the woven wire to the post at top and bottom and at intermediate points not exceeding 12 inches apart. Fasten each strand of barbed wire to each line post. Use wire ties or clamps to fasten the wires to metal posts. Securely splice the wires to the fence on both sides of the post so there are two loops behind the post and one loop in front. On wood line posts, drive U-shaped staples diagonally across the wood grain so that both points do not enter between the same grain. In depressions where wire uplift occurs, drive staples with points slightly upward. On level ground and over knolls, slope the points slightly downward. Drive the staples just short of actual contact with the wires to permit free longitudinal movement of those lines and to prevent damage to the protective coating.

At grade depressions, alignment angles, and other locations where stresses tending to pull posts from the ground or out of alignment are created, snub or guy the wire fence. Attach the guy wire to each strand of barbed wire and to the top and bottom wires of woven wire in a manner to maintain the entire fence in its normal shape. Attach the guy wire to a deadman anchor buried not less than 24 inches in the ground or to an approved anchor at a point that will best serve to resist the pull of the wire fence. If necessary to guy the fence in solid rock, grout the guy wire in a hole 2 inches in diameter and 10 inches deep. Deadman may also be fastened to posts. Place the deadman anchors at locations as directed.

Where required, install vertical cinch stays as shown. Twist the wire to permit weaving into the horizontal fence wires to provide rigid spacing. Weave barbed wires and the top, middle, and bottom wire of the woven wire, as applicable, into the cinch stay.

(3) **Tension wire.** Attach tension wire to end, gate, corner, or pull posts by bands and clamps. Either thread the top tension wire through the line post loop caps or hold in open slots in a manner to limit vertical movement. Tie or attach the bottom tension wire to the bottom of the line posts by ties or clamps in a manner that prevents vertical movement. Apply sufficient tension to avoid excess sag between posts. On the top tension wire, provide one turnbuckle or ratchet take-up in each run of fence.

(4) **Fence fabric.** For fences placed on the right-of-way, place fence fabric on the post face away from the highway. On curved alignment, place the fence fabric on the post face on the outside of the curve. For residential fences and fences off the right-of-way, place fence fabric on the post face designated by the CO.

Place the fabric approximately 1 inch above the ground and on a straight line between posts. Excavate high points of the ground to maintain grade. Do not fill in depressions without prior approval.

Stretch the fabric taut and securely fasten the fabric to the posts. Do not stretch using a motor vehicle. Use stretcher bars and fabric bands to fasten to end, gate, corner, and pull posts or weave the fabric into the fastening loops of roll-formed posts.

Fasten fabric to line posts using wire ties, metal bands, or other approved method. Fasten the top and bottom edge of the fabric with tie wires or hog rings to the top rail or tension wires, as applicable.

Join rolls of fabric by weaving a single strand into the ends of the rolls to form a continuous mesh.

(5) **Gates.** Fasten fabric to the end bars of the gate frame by stretcher bars and fabric bands. Fasten fabric to the top and bottom bars of the gate frame by tie wires similar to the method specified for fence fabric or by other approved standard methods.

Thoroughly clean welded connections on gate frames where the smelter coating has been burned with a wire brush. Remove traces of the welding flux and loose or cracked smelter. Paint the cleaned areas with two coats of zinc-oxide paint.

Provide a concrete footing for the drop-bar locking device on double metal gates. Make a hole to receive the locking bar to the depth specified by the manufacturer of the locking device.

Hinge each single gate to prevent removal of the gate without tools. Set the gate in an approximately horizontal plane. Set the gate so it swings freely inward and outward and fastens securely in its latch holder, or in the case of double gates, in its latch holder and gate stops. Set double gates on their respective hinge pintles to provide a common horizontal plane in which each single gate swings. Set gates to swing open at least 90 degrees in each direction.

(c) **Wire fences and gates.**

(1) **Posts.** Excavate holes for posts, footings, and anchors as shown. Space posts at intervals shown for the type of fence being installed. Measure post spacing interval parallel to the existing ground slope. Set posts in a vertical position. Backfill post holes in 6-inch lifts. Tamp and compact each lift.

Wood posts may be driven in place if the method of driving does not damage the post. Metal posts may be driven. Set metal corner, gate, end, and pull posts in concrete.

Where solid rock is encountered without overburden, drill line post holes at least 14 inches deep and end, corner, gate, and pull posts at least 20 inches deep in the solid rock. Make the hole width or diameter at least 1 inch greater than the post width or diameter. Cut the post to the required length before installation or drill the hole deep enough to set the post at the required height. Set and plumb the post and fill the hole with grout. Thoroughly work the grout into the hole to eliminate voids. Crown the grout to drain water away from the post. Metal posts set in this manner do not require anchor plates and concrete footings.

Where solid rock is covered with soil or loose rock overburden, set posts to the plan depth or to the minimum depth into the solid rock as specified above, whichever is less. When the depth of overburden is greater than 12 inches, use an anchor plate on steel line posts and backfill steel end, corner, gate, and pull posts with concrete from the solid rock to top of the ground. When the depth of overburden is 12 inches or less, anchor plates and concrete backfill are not required. Grout the portion of the post in solid rock.

Where existing fence intersects the new fence, cut the existing fence materials or, splice in kind, new material as necessary, and fasten each longitudinal wire of the woven wire and each strand of the barbed wire to a new end post in line with or immediately adjacent to the new fence line.

(5) Gate installation.

(a) *Wire gates.* Construct wire gates of the same material as the fence and as shown. Provide a taut and well-aligned closure of the opening, capable of being readily opened and closed by hand.

(b) *Metal gates.* Install metal gates and fittings to gate posts previously set. Firmly attach the fittings to the posts and gates. Hinge each single gate to prevent removal of the gate without tools. Set the gate in an approximately horizontal plane. Set the gate so it swings freely inward and outward and fastens securely in its latch holder, or in the case of double gates, in its latch holder and gate stops. Set double gates and their respective pintles to provide a common horizontal plane in which each single gate swings. Set gates to swing open at least 90 degrees in each direction.

For double gates, provide a drop-bar locking device with a concrete footing 12 inches in diameter and 12 inches deep. Crown the top of the footing and make a hole to receive the locking bar. Make the diameter and depth of the hole in the footing as specified by the manufacturer of the locking device.

(c) *Wood gates.* Install wood gates similar to metal gates and as shown.

619.04 Grounding Fences. Where an electric line crosses the fence line, ground the fence. Drive an 8-foot long, 0.50-inch minimum diameter galvanized or copper coated steel rod into the ground under the fence directly below the point of crossing. Drive the rod vertically until the top is 6 inches below the ground surface. Connect the grounding rod to each fence element with a 0.2-inch diameter solid copper conductor or equivalent. Either braze the connections or fasten with noncorrosive clamps.

Where an electric line runs parallel or nearly parallel to and above the fence, ground the fence at each end or gate post or at intervals not exceeding 1,600 feet.

Where vertical penetration of the grounding rod cannot be accomplished, use an equivalent horizontal grounding system.

619.05 Remove and Reset Fence. Remove existing fence and reset to approximately the same condition as the original fence. Salvage material in the existing fence and incorporate the material into the reset fence. When posts are set in concrete, remove concrete from old post and reset in concrete. Replace fence material damaged beyond reuse. Firmly reset posts on new alignment. Space posts and attach the horizontal members or wires to posts the same as the original fence. Furnish and use new material to fasten members or wires to posts.

619.06 Temporary Fence. When necessary, construct temporary fence to keep livestock and traffic off the road being constructed. Temporary fence is intended to remain in place only during the construction of the project or until the fence is directed to be removed.

Construct a temporary fence of a type that provides an adequate enclosure for the type of livestock to be confined.

619.07 Cattle Guards.

(a) **Excavating and backfilling.** Perform the work described under Section 209. Excavate foundation to depth with sufficient space for proper installation of formwork.

When the cattle guard is to be installed on new embankment, complete and compact the embankment according to Section 204 before excavating for footing.

(b) **Concrete foundation.** Construct concrete foundations according to Section 601. Concrete units may be cast-in-place or precast.

Finish stringer bearings to allow full bearing under each stringer. The cattle guard shall rest on the concrete without rocking.

(c) **Cattle guard.** Fabricate cattle guard according to Section 555. Assemble and place guards as shown on the plans. Securely fasten the cattle guard to the foundation. Fasten the metal wings to the cattle guard as shown on the plans. Connect fences and gates according to the plans. Weld according to ANSI/AASHTO/AWS D1.5.

Standard manufactured cattle guards may be used if approved. Designs shall provide for AASHTO loading M-18. Suitable cleanouts shall be provided. Prepare and submit drawings according to Subsection 104.03. Acceptance of the drawings covers the requirements for strength and detail only. No responsibility is assumed for errors in dimensions.

(d) **Painting.** All metal parts shall receive one shop coat. Two additional coats are required and may be applied in the shop or in the field. Paint according to Section 563.

19.08 Bollards. Drill holes for bollards. Set posts plumb, backfill with approved material, and compact.

19.09 Acceptance. Material for fences, gates, cattle guards, and bollards will be evaluated under Subsections 106.02 and 106.03.

Construction and erection of fences, gates, cattle guards, and bollards will be evaluated under Subsections 106.02 and 106.04.

Excavation and backfill for cattle guards will be evaluated under Section 209.

Structural steel work for cattle guards will be evaluated under Section 555.

Painting of cattle guards will be evaluated under Section 563.

Concrete work for cattle guards will be evaluated under Section 601.

Measurement

19.10 Measure fence and remove and reset fence by the linear foot along the top of the fence.

Measure gates, cattle guards, brace panels, and bollard posts by the each.

Payment

619.11 The accepted quantities, measured as provided above, will be paid at the contract price per unit of measurement for the pay items listed below that are shown in the bid schedule. Payment will be full compensation for the work prescribed in this Section. See Subsection 109.05.

Payment will be made under:

Pay Item	Pay Unit
61901 Fence <u>(description)</u>	Linear foot
61902 Gate <u>(description)</u>	Each
61903 Cattle guard, ___ foot	Each
61904 Brace panel	Each
61905 Bollard post	Each
61906 Remove and reset fence	Linear foot

SECTION 15400 - PLUMBING

PART 1 - GENERAL

1.01 SUMMARY

- A. Provide plumbing systems including supply, waste and vent systems for:
 1. Toilet rooms.
 2. Potable cistern water system: valves, piping pumps, etc.
 3. Sub-surface Oil separators for surface water drainage system.
 4. Water heaters.
 5. Floor drains.
 6. Service sinks.
 7. A/C condensate drainage system to plumbing waste lines.
 8. Storm drainage.
 9. Access panels.
- B. Modify and extend existing service to accommodate new work. Remove existing systems and piping no longer required.
- C. Coordinate with Owner's room uses to provide adequate system for all contract areas.
- D. Coordinate location of plumbing systems to avoid interference with location of structure and other building systems. Notify Owner prior to construction of conflicts which cannot be resolved. Locate cistern pumps as directed by owner.

1.02 SUBMITTALS

- A. Submit for approval shop drawings, product data, fixture cuts, record documents.

1.03 QUALITY ASSURANCE

- A. Comply with governing codes and regulations. Provide products of acceptable manufacturers which have been in satisfactory use in similar service for three years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions.
- B. Arrangement of systems indicated on the drawings is diagrammatic, and indicates the minimum requirements for plumbing work. Site conditions shall determine the actual arrangement of runs, bends, offsets, and similar items. Take field measurements before fabrication. Be responsible for accuracy of dimensions and layout. Overhead piping shall be laid out to obtain maximum head room.

PART 2 - PRODUCTS

4.01 MATERIALS

- A. Provide plumbing systems components and all required accessories including shut-offs and clean-outs. Provide components which prevent back-siphonage or cross-connections.
- B. Sanitary, waste and vent piping:
 - no-hub pipe with MG joints or clamp-all couplings for pipe 2-1/2" and larger. Service weight cast iron
 - for 2" and smaller waste pipe.
- C. Hot and cold water piping: Type 2 seamless hard drawn copper tubing assembled with solder fittings. Support piping with grade to drain to drainoff cocks.
- D. Hangers: For cast iron, provide heavy wrought iron pipe hangers, brackets or clamps at 5' intervals. Fasten with lag screw or with expansion shields as applicable. For water piping, provide adjustable wrought iron copper plated hangers at 6' intervals maximum. Provide hangers to allow for full thickness of insulation.
- E. Sleeves and escutcheons: Galvanized wrought iron. Where uncovered pipes pass through finished areas, provide heavy chromium escutcheons.
- F. Covering and insulation: For domestic hot and cold water piping provide 1/2" flexible foamed tubing by Owens Corning or Armstrong 1/2" Armaflex or approved equal. Seal joints vapor tight. Insulate valves and fittings including water service piping with equal thickness of pipe insulation. Provide 18 gauge protection saddles between insulation and pipe hangers. Comply with fire hazard regulations.
- G. Valves and shut-offs: Full size bronze gate valves for hot and cold water branches. Provide drainage valves. Provide units by Hammond, Jenkins, Nibco or approved equal.
- H. Hose bibbs: Anti-siphon nose bibbs by Woodford or approved equal.
- I. Floor drains and cleanouts: Units with bronze strainer and copper flashing by Zurn or approved equal.
- J. Shock absorbers: Units by Zurn or approved equal.
- K. Domestic water mixing valve: Self-contained thermostatic type including hot water temperature limit, check valves, strainers and stop valves by Leonard, Symmons, Johnson or approved equal.

L. Water heater: Glass lined storage type for utility service at site. Provide baked enamel steel jacket, fiberglass insulation, and UL flame retention burner; 10 year warranty.

M. Water cooler: Stainless steel dual drinking fountain by Haws, Casis or approved equal.

N. Cistern pumps: STA-RITE: Type 'S', A.O.SMITH, 115 Volts, 1/3 HP.

P. Access panels: Metal units with locks by Karp, Milcor, Nystrom or approved equal. Configuration and trim as required by finish wall surface.

3.02 FIXTURE SCHEDULE

A. Water closets and accessories: White vitreous china syphon jet elongated water closet to operate on 3 gallons of water or less, and as required by code by Kohler, Eljer, American Standard or approved equal. Water closet fixture supports by Smith Manufacturing or approved equal. Water closet flushometers by Sloan Royal or approved equal. Elongated white contoured toilet seats with encased stainless steel hinges.

B. Urinals and accessories: White vitreous china washout action urinal with outlet, wall hanger, and removable beehive strainer by Kohler, Eljer, American Standard or approved equal. Urinal flushometers by Sloan Royal or approved equal. Steel urinal wall supports by Zurn or approved equal.

C. Lavatories and accessories: 18" diameter, white self-rimming acid-resisting enameled cast iron round lavatories with 4" faucet centers by Kohler, Eljer, American Standard or approved equal. Faucets with water guard feature, perforated strainer, tail piece.

D. Service sinks and accessories: White acid-resisting enameled cast iron service sink with stainless steel rim guard and wall hanger by Kohler or approved equal. Trap standard with cleanout plug and strainer. Faucet with vacuum breaker, threaded spout and pail hook.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install materials and systems in accordance with manufacturer's instructions and approved submittals. Install materials in proper relation with adjacent construction and with uniform appearance for exposed work. Coordinate with work of other sections. Comply with applicable regulations and building code requirements.
- B. Support piping properly. Pitch to drain points. Install with pipe expansion loops, mechanical expansion joints, and anchors.
- C. Install shutoff valves on each piece of equipment on both hot and cold water supply.
- D. Clearly label all valves and components.
- E. Sterilize water distribution system. Flush and test all systems for proper operation. Adjust system to prevent water hammer.
- F. Restore damaged finishes. Clean and protect work from damage.
- G. Instruct Owner's personnel in proper operation of systems.

END OF SECTION

SECTION 10160 - TOILET PARTITIONS

PART 1 - GENERAL

1.01 SUMMARY

A. Provide toilet partitions and screens.

1. Floor-supported partitions.

2. Floor-supported screens.

1.02 SUBMITTALS

A. Submit for approval samples, shop drawings, product data.

1.03 QUALITY ASSURANCE

A. Comply with governing codes and regulations. Provide products of acceptable manufacturers which have been in satisfactory use in similar service for three years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Metal partitions:

1. Steel with baked enamel finish; ASTM A 591, Class C, galvanized and bonderized; Sanymetal Products Co or approved equal.

B. Plastic laminate faced partitions: Pressure-laminated one-piece face sheets, 0.062" thick; Sanymetal Products Co or approved equal.

C. Fittings: Door latches and coat hook on inside face of door.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install materials and systems in accordance with manufacturer's instructions and approved submittals. Install materials and systems in proper relation with adjacent construction and with uniform appearance. Coordinate with work of other sections.
- B. Limit openings between panels, doors and pilasters to less than 1/2".
- C. Adjust hardware, clean, and protect work.

END OF SECTION

PART 1 - GENERAL

1.01 SUMMARY

- A. Provide toilet accessories.

1.02 SUBMITTALS

- A. Submit for approval samples, product data, accessory schedule.

1.03 QUALITY ASSURANCE

- A. Comply with governing codes and regulations. Provide products of acceptable manufacturers which have been in satisfactory use in similar service for three years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Units: Stainless steel fabrication with NAAMM No. 4 bright directional polish finish; Bobrick Washroom Equipment, Inc., Bradley, McKinney-Parker, or approved equal. Surface and recessed mounting as indicated.

- B. Types and quantities:

- 1. Towel dispenser; 1 per toilet room.
- 2. Waste dispenser; 1 per toilet room.
- 4. Toilet tissue dispenser, double roll; 1 per stall.

- 7. Soap dispenser; 1 per basin.
 - a) Deck-mounted.

- 8. Grab bars; 1 pair per handicapped stall.
- 9. Shelf; 1 per toilet room.

- 14. Towel bars; 2 per toilet room.
- 15. Soap disp; 1 per lavatory.
- 16. Mirror units; 1 per lavatory and as indicated.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install materials and systems in accordance with manufacturer's instructions and approved submittals. Install materials and systems in proper relation with adjacent construction and with uniform appearance. Coordinate with work of other sections.
- B. Restore damaged finishes and test for proper operation. Clean and protect work from damage.

END OF SECTION

SECTION 16000 ELECTRICAL

PART 1 - GENERAL

1.01 SUMMARY

A. Provide electrical systems including:

1. Power.
2. Lighting.
3. Exit lighting.
4. Emergency lighting.
5. Full service electric power generator incl. automatic switching.
6. Site lighting.
7. Electric heating equipment.
8. Sound system.
9. Life safety systems.
10. Security systems.
11. Fiber optic light system, for signage
12. Cable TV system.
13. Cistern pump systems

- B. Include primary service, transformers, distribution center, grounding, power and lighting panels, wiring, outlet boxes, receptacles, lighting fixtures, switches, conduits, and raceways and all accessories.
- C. Provide telephone and data outlets with cutout, box and pull string only.
- D. Modify and extend existing service to accommodate new work. Relamp existing fixtures consistent with building standards. Remove existing systems and wiring which are abandoned.
- E. Maintain fire alarm system in operation during construction.
- F. Coordinate with Owner's room uses to provide adequate system for all contract areas.
- G. Coordinate location of ductwork and fire protection systems to avoid interference with location of designated lighting fixture locations. Notify Owner prior to construction of conflicts which cannot be resolved.
- H. Coordinate schedule of telephone and data outlet completion with Owner's communications requirements and installer as applicable.

1.02 SUBMITTALS

- A. Submit for approval shop drawings and circuit diagrams, product data, record documents.

1.03 QUALITY ASSURANCE

- A. Comply with governing codes and regulations. Provide products of acceptable manufacturers which have been in satisfactory use in similar service for three years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions.
- B. Arrangement of systems indicated on the drawings is diagrammatic, and indicates the minimum requirements for electrical work. Site conditions shall determine the actual arrangement of conduits, boxes, and similar items. Take field measurements before fabrication. Be responsible for accuracy of dimensions and layout.
- C. Comply with the National Electrical Code and applicable local regulations.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Conduit: Rigid galvanized metal conduit, intermediate metallic conduit, electrical metallic tubing for concealed interior raceways, flexible metal conduit, and rigid nonmetallic conduit as required.
- B. Exposed metal raceways by Wiremold, Walker Parkersburg or approved equal where wiring cannot be concealed.
- C. Boxes: Provide galvanized steel outlet, junction and pull boxes sized to meet requirements of National Electrical Code. Provide outlet boxes for 48 volt emergency lights with blank covers painted yellow.
- D. Conductors and wiring: 600 volt insulation type THWN or THHN copper wiring for branch circuits. Conductors AWG No. 12 shall be solid. Conductors AWG No. 10 and larger stranded. Minimum conductor size AWG No. 12. Green ground conductor in all raceways. Other sizes as required by service intended.
- E. Wiring devices: Receptacles, lighting switches, ground fault receptacles, dimmers, and coverplates as required.
- F. Panelboards as required by National Electrical Code.
- G. Fixtures: Fluorescent fixtures with ETL/CBM approved high power factor with quiet energy-saving rapid-start ballasts. Provide wattmiser lamps and acrylic prismatic lenses. Provide and install fluorescent fixtures with 30% circuited for emergency lighting as directed by owner. Flexible, non-electric fiber optic light system by "FIBERSTAP" as detailed.

Unesco or approved equal to control light fixtures in designated areas such as toilet and utility rooms.

1. Provide and install, full service emergency electric power generator. ONAN, DIESEL SET, Industrial type, Kilowatt rating-60Hz, stand power; Brand, Cummins/onan; broad-range voltage, 120/208, 3ph Wye; main line circuit breaker 350A, 3P, 240V, Mtd; Alternator control panel, w/ meters; Engine exh. connector-N Engine exhaust muffler-critical; Fuel tank-sub-base-, 24, hr One year warranty; Option, battery-12v, 620 CCA; Switch-basic Transfer; UL listing: Voltage-208/120V, 3PH, 4W; Battery charge-2A, 12, 12/24V; Clock-7 day exercise Switch-Auto/Manual Change.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install materials and systems in accordance with manufacturer's instructions and approved submittals. Install materials in proper relation with adjacent construction and with uniform appearance for exposed work. Coordinate with work of other sections. Comply with applicable regulations and building code requirements.
- B. Comply with National Electrical Code and building code requirements. Maintain continuity of circuits required to supply new or existing equipment in service.
- C. Center ceiling-mounted elements in center of ceiling tiles as applicable.
- D. Install light switches 48" above finished floor. Locate switches within rooms at strike side of door unless noted otherwise.
- E. Motor cables and controls, connect to supervisor's office for bus entrance gate operation as directed by owner.
- F. Gang-mount multiple switching locations. Mount multiple types of controls as close together as possible and in-line with each other at a height of 48" above finished floor.
- G. Group multiple junction boxes, telephone and electrical outlets together on wall not more than 6" apart. Avoid back-to-back box locations.
- H. Mount electrical, data, and telephone outlets vertically, 18" above finished floor unless noted otherwise.
- I. Test all systems for proper operation. Restore damaged finishes. Clean and protect work from damage.
- J. Instruct Owner's personnel in proper operation of systems.

END OF SECTION

Section 634.- PERMANENT PAVEMENT MARKINGS

Description

634.01 This work consists of applying permanent pavement markings and raised pavement markers on the completed pavement.

Pavement markings are designated as follows:

- Type A Conventional traffic paint with type 1 glass beads
- Type B Waterborne traffic paint with type 1 glass beads
- Type C Waterborne traffic paint with type 3 glass beads
- Type D Epoxy markings with type 1 glass beads
- Type E Epoxy markings with type 1 and type 4 glass beads
- Type F Polyester markings with type 1 glass beads
- Type G Polyester markings with type 1 and type 4 glass beads
- Type H Thermoplastic markings with type 1 glass beads
- Type I Thermoplastic markings with type 1 and type 5 glass beads
- Type J Preformed plastic markings
- Type K Nonreflectorized markings

Material

634.02 Conform to the MUTCD and the following Subsections:

Conventional traffic paint	718.13
Epoxy markings	718.15
Epoxy resin adhesives	718.23
Glass beads	718.19
Polyester markings	718.16
Preformed plastic markings	718.18
Raised pavement markers	718.20
Thermoplastic markings	718.17
Waterborne traffic paint	718.14

Construction Requirements

634.03 General. Where existing and final pavement marking locations are identical, stake the limits of all existing pavement markings (no-passing zones, edge stripes, etc.) before any pavement work. Upon completion of the final surface course, establish line limits for the new pavement for approval before marking. Establish markings according to the MUTCD.

Remove loose particles, dirt, tar, grease, and other deleterious material from the surface to be marked. Where markings are placed on portland cement concrete pavement less than 1 year old, clean the pavement of all residue and curing compounds. Remove temporary pavement markings the same day permanent pavement markings are applied. Apply markings to a clean, dry surface according to the MUTCD.

At least 7 days before applying pavement markings, furnish a written copy of the marking manufacturer's recommendations for use. A field demonstration may be required to verify the adequacy of recommendations.

Ship marking material in appropriate containers plainly marked with the following information as appropriate for the material being furnished:

- (a) Manufacturer's name and address
- (b) Name of product
- (c) Lot/batch numbers
- (d) Color
- (e) Net mass and volume of contents
- (f) Date of manufacture
- (g) Date of expiration
- (h) Statement of contents (if mixing of components is required)
- (i) Mixing proportions and instructions
- (j) Safety information

Apply pavement markings in the direction of traffic according to the manufacturer's recommendations. Apply all markings to provide a clean-cut, uniform, and workmanlike appearance by day and night.

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Make lines 4 inches wide. Make broken lines 10 feet long with 30-foot gaps. Make dotted lines 2 feet long with 4-foot gaps. Separate double lines with a 4-inch space.

Protect marked areas from traffic until the markings are dried to no-tracking condition. Remove all tracking marks, spilled marking material, markings in unauthorized areas, and defective markings.

634.04 Conventional Traffic Paint (Type A). Apply paint when the pavement and air temperatures are above 40°F. Spray paint at 15 mil minimum wet film thickness before glass beads or at a rate of 107 square feet per gallon. Immediately apply type 1 glass beads on the paint at a minimum rate of 6 pounds per gallon of paint.

On new asphalt pavements or new asphalt surface treatments, apply two coats. Apply the first coat at 360 square feet per gallon and the second coat at 150 square feet per gallon.

634.05 Waterborne Traffic Paint (Type B and C). Apply paint when the pavement and air temperatures are above 50°F. Spray paint at 15 mil minimum wet film thickness before glass beads or at a rate of 107 square feet per gallon.

Type B. Immediately apply type 1 glass beads on the paint at a minimum rate of 6 pounds per gallon of paint.

Type C. Immediately apply type 3 glass beads on the paint at a minimum rate of 12 pounds per gallon of paint.

On new asphalt pavements or new asphalt surface treatments, apply two coats. Apply each coat at 210 square feet per gallon.

634.06 Epoxy Markings (Types D and E). Heat components A and B separately at $110 \pm 30^\circ\text{F}$ and mix. Discard all material heated over 140°F. Apply epoxy when the pavement and air temperatures are above 50°F. Apply as a spray at $110 \pm 30^\circ\text{F}$ (gun tip temperature) at a 15 mil minimum dry film thickness or 107 square feet per gallon.

Type D. Immediately apply type 1 glass beads on the epoxy at a minimum rate of 15 pounds per gallon of epoxy.

Type E. Use two bead dispensers. Immediately apply type 4 glass beads on the epoxy at a minimum rate of 12 pounds per gallon of epoxy immediately followed by an application of type 1 glass beads at a minimum rate of 12 pounds per gallon.

634.07 Polyester Markings (Types F and G). Apply polyester when the pavement and air temperatures are above 50°F. Spray at $128 \pm 7^\circ\text{F}$ (gun tip temperature) at a 15 mil minimum dry film thickness or 107 square feet per gallon. Discard all material heated over 150 °F. Do not use fast dry polyester markings on hot asphalt concrete pavements less than 1 year old.

Type F. Immediately apply type 1 glass beads on the polyester at a minimum rate of 15 pounds per gallon of polyester.

Type G. Use two bead dispensers. Immediately apply type 4 glass beads on the polyester at a minimum rate of 12 pounds per gallon of polyester immediately followed by an application of type 1 glass beads at a minimum rate of 12 pounds per gallon.

634.08 Thermoplastic Markings (Type H and I). On areas to be marked on portland cement concrete pavements and old asphalt pavements, apply an epoxy resin primer/sealer according to the thermoplastic manufacturer's recommendations. Allow the primer/sealer to dry.

Apply thermoplastic when the pavement and air temperatures are above 50 °F. Spray or extrude the thermoplastic at $430 \pm 5^\circ\text{F}$. For centerlines and lane lines, spray or extrude 90 mil minimum dry film thickness or at a rate of 17.8 square feet per gallon. For edge lines, spray or extrude 60 mil minimum dry film thickness or at a rate of 26.7 square feet per gallon.

Type H. Immediately apply type 1 glass beads on the thermoplastic at a minimum rate of 12 pounds per 100 square feet.

Type I. Use two bead dispensers. Immediately apply type 5 glass beads on the thermoplastic at a minimum rate of 12 pounds per 100 square feet immediately followed by an application of type 1 glass beads at a minimum rate of 12 pounds per 100 square feet.

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The minimum bond strength of the thermoplastic shall be 175 pounds per square inch on portland cement concrete pavements.

634.09 Preformed Plastic Markings (Type J). Install to form a durable, weather resistant bond to the pavement. Apply preformed plastic markings according to the manufacturer's recommendation.

Where applied during final compaction of asphalt pavement, apply preformed plastic when the pavement temperature is about 140 °F. Roll the marking into the surface with a steel wheel roller. The finished pavement marking may extend approximately 10 mil above the final surface.

634.10 Nonreflectorized Markings (Type K). Apply conventional traffic paint, waterborne traffic paint, epoxy markings, polyester markings, or thermoplastic markings as described above, but with no glass beads added.

634.11 Raised Pavement Markers. Install raised pavement markers when the pavement and air temperatures are above 50°C. Apply raised pavement markers with epoxy resin or asphalt adhesive.

Heat epoxy components A and B separately with indirect heat, mix, and apply at 70±10 °F. Discard all material heated over 120 °F or stiffened by polymerization.

Heat and apply asphalt adhesives at 412±12 °F. Discard all material heated over 450 °F.

Space and align the markers to within 0.50 inches of the required location. Do not place raised pavement markers over pavement joints.

The minimum bond strength shall be 1.75 pounds per square inch or a total tensile strength of 25 pounds.

634.12 Acceptance. Material for permanent pavement markings will be evaluated under Subsections 106.02 and 106.03.

Placement of permanent pavement marking will be evaluated under Subsections 106.02 and 106.04.

Measurement

634.13 Measure pavement markings by the linear foot, by the gallon, by the square foot, or by the station. When two coats of paint are required, measure each coat for payment.

(a) When pavement markings are measured by the linear foot or station, measure the length of line applied along the centerline of each 4-inch-wide line applied regardless of color. Measure broken or dotted pavement lines from end to end of the line including gaps. Measure solid pavement lines from end to end of each continuous line. For line widths other than 4 inches, the measured length of line is adjusted in the ratio of the required width to 4 inches.

(b) When pavement markings are measured by the square foot, measure the number of square feet of symbol or letter marking based on the marking area shown in the contract or, if not shown, the area of each marking measured in place to the nearest square foot.

Measure raised pavement markers by the each.

Payment

634.14 The accepted quantities, measured as provided above, will be paid at the contract price per unit of measurement for the pay items listed below that are shown in the bid schedule. Payment will be full compensation for the work prescribed in this Section. See Subsection 109.05.

Payment will be made under:

Pay Item	Pay Unit
63401 Pavement markings type ____	Linear foot
63402 Pavement markings type ____	Square foot
63403 Pavement markings type ____	Gallon
63404 Pavement markings type ____	Station
63405 Raised pavement markers	Each

Section 635.- TEMPORARY TRAFFIC CONTROL

Description

635.01 This work consists of furnishing, maintaining, relocating, and re-moving temporary traffic control devices and services as ordered for the control and protection of public traffic through the project.

Advance warning arrow panel, barricade, and warning light types are designated as shown in the MUTCD.

Material

635.02 Conform to the MUTCD and the following Sections and Subsections:

Construction sign panels	633
Crash cushion barrels	710.12
Retroreflective sheeting	718.01
Temporary concrete barrier	618
Temporary plastic fence	710.11
Temporary guardrail	617
Temporary pavement markings	718.21
Temporary traffic control devices	718.22
Traffic markings	634

Construction Requirements

635.03 General. Install and maintain temporary traffic control devices adjacent to and within the project as required by the traffic control plan, Section 156, and the MUTCD. Install and maintain traffic control devices as follows:

- Furnish and install traffic control devices before the start of construction operations.
- Install only those traffic control devices needed for each stage or phase.
- Relocate temporary traffic control devices as necessary.
- Remove devices that no longer apply to the existing conditions.

(e) Immediately replace any device that is lost, stolen, destroyed, or inoperative.

(f) Keep temporary traffic control devices clean.

(g) Furnish and maintain traffic control devices that meet the "acceptable" standard described in *Quality Standards for Work Zone Traffic Control Devices* published by ATSSA. Amend the ATSSA standards as follows:

(1) Repair or remove and replace "marginal" devices within 48 hours.

(2) Repair or remove and replace "unacceptable" devices immediately.

(h) Remove all temporary traffic control devices upon contract completion or when approved.

635.04 Advance Warning Arrow Panels. Perform the work described under MUTCD Part VI.

635.05 Barricades. Perform the work described under MUTCD Part VI. Use type III or IV retroreflective sheeting. Use wood, metal, or plastic barricades. When type II barricades are used, use barricades that collapse when tipped over.

635.06 Cones and Tubular Markers. Perform the work described under MUTCD Part VI. Use 28-inch cones or tubular markers. Use type III, IV, or VI retroreflective sheeting.

635.07 Construction Signs. Use type III or IV retroreflective sheeting. Remove or completely cover all unnecessary signs with metal, plywood, or other acceptable material.

Use wood, metal, fiberglass, or other approved posts. Use breakaway posts within the traversable area adjacent to traffic. Install posts according to Section 633.

635.08 Drums. Perform work described in MUTCD Part VI. Use plastic drums that are approximately 36 inches high and a minimum of 18 inches in diameter. Use type III, IV, or VI retroreflective sheeting.

635.09 Flaggers. Furnish flaggers certified by ATSSA or a state agency. Perform the work described under MUTCD Part VI. Use type III or IV retroreflective sheeting on flagger paddles. Do not use flags.

635.10 Pilot Cars. Perform the work described under MUTCD Part VI. Employ pilot car operators meeting the minimum qualifications of a flagger according to Subsection 635.09. Mount a rotating amber beacon on the roof of each pilot car. Do not use strobe light beacons.

635.11 Temporary Concrete Barriers. Perform the work described under MUTCD Part VI. Furnish temporary concrete barriers that are new or used provided they are not badly damaged. Lifting holes no larger than 4 inches provided they are permitted. Individual sections may vary in length. Connect sections so they do not separate when struck by a vehicle.

Mount 3-inch minimum dimension white or yellow retroreflectors, as applicable, to the top or side of the barrier on 25-foot centers. Mount the retroreflectors at a uniform height at least 2 feet above the pavement surface.

635.12 Temporary Guardrail. Used guardrail material may be used with approval. Construct temporary guardrail according to Section 617.

Mount 3-inch minimum dimension white or yellow retroreflectors, as applicable, to the top or side of the guardrail on 25-foot centers. Mount the retroreflectors at a uniform height at least 2 feet above the pavement surface.

635.13 Temporary Pavement Markings and Delineation. Before opening a pavement surface to traffic, provide acceptable pavement markings or delineation and signing according to Section 156 and the MUTCD.

For temporary pavement markings, use preformed retroreflective tape, traffic paint, or temporary raised pavement markers as follows:

(a) **Preformed retroreflective tape.** Apply according to the manufacturer's instructions. Remove all loose temporary preformed retroreflective tape before placing additional pavement layers.

(b) **Traffic paint.** Do not apply temporary traffic paint to the final surface. Apply traffic paint as the temporary pavement marking if no work will be performed on the project for at least 30 consecutive days. Apply temporary traffic paint at a 15-mil minimum wet film thickness (0.9 gallon per 100 square feet). Immediately apply type 1 glass beads on the paint at a minimum rate of 6 pounds per gallon of paint.

(c) **Raised pavement markers.** Do not use raised pavement markers during seasonal suspensions. When chip seals, slurry seals, or tack coats are used after marker placement, protect the markers with an approved protective cover, which is removed after the asphalt material is sprayed. Temporary raised pavement markers may be used as temporary pavement markings as follows:

(1) **10-foot broken line.** Four pavement markers spaced 3.33 feet apart followed by a 30-foot gap.

(2) **4-foot broken line.** Three pavement markers spaced 2 feet apart followed by a 36-foot gap.

(3) **2-foot broken line.** Two pavement markers spaced 2 feet apart followed by an 18-foot gap.

(4) **Solid line.** Pavement markers on 5-foot centers.

Remove all temporary raised pavement markers before placing additional pavement layers.

Install and maintain temporary pavement markings that are neat, crack free, true, straight, and unbroken.

Remove all temporary pavement markings from the surface course before placing permanent pavement markings.

Remove all conflicting pavement markings by sandblasting or other methods, that do not damage the surface or texture of the pavement. Make the removal pattern uneven so it does not perpetuate the outline of the removed pavement markings. Lightly coat sandblasted or removal areas on asphalt surfaces with mulitified asphalt.

635.14 Vertical Panels. Perform the work described under MUTCD Part VI. Use wood, metal, or plastic vertical panels. Use type III or IV retro-reflective sheeting.

635.15 Warning Lights. Perform the work described under MUTCD Part VI. When type C, steady-burn, warning lights are installed on barricades or drums and used in a series for delineation, use type A, flashing, warning lights on the first 2 barricades or drums in the series. Mount batteries for type B warning lights a maximum of 12 inches from ground or roadway surface as measured to top of the battery casing.

635.16 Shadow Vehicle. Furnish a shadow vehicle (15,000-pound gross vehicle weight minimum) equipped with a truck-mounted attenuator (crash cushion) attached to the rear of the vehicle, exterior flashing yellow dome light, and an advance warning arrow panel. Furnish the advance warning arrow panel according to Subsection 635.04.

Use the shadow vehicle to provide physical protection to workers from traffic approaching from the rear during moving operations (i.e. pavement markings, traffic control set up and removal, etc.). Use the following procedures to close a lane of traffic. Alternate procedures may be used if approved by the CO.

- (a) Move the shadow vehicle to a point approximately 200 feet from the first advance warning sign for the lane closure and stop on the shoulder.
- (b) Activate the flashing lights and flashing arrow panel. Begin the arrow panel in the caution mode and after approximately 2 minutes display the correct flashing pass arrow.
- (c) Move the shadow vehicle (now acting as a protection vehicle) along the shoulder to the first sign location, stopping approximately 100 feet before the sign location in a blocking position.
- (d) Install the first sign then proceed to the next advance sign location. Repeat Step (c) for the second sign and install that sign. Repeat this procedure until all advance warning signs are installed.

(e) After installing all of the advanced warning signs for the lane closure, move the shadow vehicle into the lane that is to be closed to a position 100 feet in advance of the closing taper location. Install the channelizing devices for the taper in the shielded lane.

(f) Move the shadow vehicle off the roadway and past the taper on the shoulder and remain in position until the flashing arrow panel for the closure (if one is to be provided) is placed and operating. Move the shadow vehicle with the workers as they proceed to set up the remaining devices as additional protection.

635.17 Pavement Patch. Furnish an asphalt mix according to Section 401, 402, or 417 to repair potholes and rough spots in the traveled way before reopening travel lanes to traffic.

635.18 Variable Message Sign. Furnish a self-contained, trailer mounted sign system consisting of a sign message panel, controller, power source, and structural support system. Make the trailer and sign support system safety orange. Furnish a sign system that:

- (a) Has a 3 line sign message panel containing at least 8 modular and interchangeable bulb or dot matrix assemblies per line, each capable of displaying a character.
 - (1) *Bulb matrix.* Furnish a sign panel assembly containing eight lamp bank matrices with a minimum of 7 X 5 lamps per line, which displays up to eight characters minimum, 18 inches minimum in height. Furnish rugged, high performance, 2 inches diameter, sealed beam unit lamps rated at 24 volts, 20 watts with a minimum light output of 8600 lux.
 - (2) *Dot matrix.* Furnish a dot matrix assembly containing electronically activated fluorescent yellow dots. Illuminate the sign panel by internal backlight. Activate the backlight system by photo cell system to measure both vertical and horizontal ambient lighting. Provide a manual over-ride switch to deactivate the photo cell system.
- (b) Is legible from a distance of 900 feet.
- (c) Cycles messages so 3 message cycles are displayed to the driver while approaching the sign at 55 miles per hour from 900 feet.

- (d) Operates on a continuous basis for at least 5 days.
- (e) Electrically and manually raises the message panel in the vertical axis a minimum of 7 feet above the pavement surface.
- (f) Rotates the message panel 30 degrees vertically and 360 degrees horizontally and stops in any position.
- (g) Allows the entry of all sign and message functions from a controller in a control cabinet on the trailer mounted unit.
- (h) Has a start/stop switch on the controller to activate the power supply and sign panel.
- (i) Requires an entry code for entry into the controller to access the memory and display messages.
- (j) Has a keyboard to generate and store a minimum of 20 preprogrammed or newly composed messages.

635.19 Temporary Crash Cushions.

- (a) **Crash cushion barrels.** Provide and install all parts of the completed barrels including placement of sand according to the manufacturer's recommendations. After the barrels are set and the sand placed, secure the lids in place to prevent loss or theft. If the barrels are placed on surfaces subject to vibrations or on steep slopes, secure the barrels according to the manufacturer's recommendations.

- (b) **GREAT system.** Provide a 3-bay (or 6-bay) Construction Zone Guardrail Energy Absorbing Terminal (GREAT) crash cushion manufactured by Energy Absorption Systems, Inc., or an approved equal. Maintain 8 additional cartridges for use in reestablishing damaged systems. Mount type II retroreflective sheeting to the front face.

635.20 Temporary Signal System. Design, furnish, and install a temporary signal system according to Section 636 and MUTCD Part IV. Furnish either new or used material for temporary traffic signal systems. Used material is subject to the CO's approval.

Furnish signal heads with three lenses, minimum 8 inches diameter, indicating red, yellow, and green phases. Furnish a signal controller capable of operating in either the solid red, solid green, or a red/yellow/green mode for each signal.

635.21 Temporary Fence. Provide and install temporary fence according to Section 619.

635.22 Portable Rumble Strip. Provide and install a strip 10 feet long, 18 inches wide, and 0.12 inches high to alert drivers of an approaching flagger station or work area.

635.23 Opposing Traffic Lane Divider. Provide and install 12-by-18-inch signs mounted on flexible supports on a temporary centerline to remind drivers of a two-way traffic pattern on sections that are normally one-way.

635.24 Steel Plates. Furnish 1-inch or thicker steel plates capable of safely carrying traffic. Secure the plates to the pavement to prevent any movement.

635.25 Acceptance. Material (including signs, barrels, barricades, cones, tubular markers, crash cushions, concrete barriers, dividers, fence, guardrail, pavement markings, rumble strips, traffic signals, lights, and vertical panels) for temporary traffic control devices will be evaluated under Subsections 106.02 and 106.03. Vehicles for pilot cars and shadow vehicles will be evaluated under Subsection 106.02.

Placement of temporary traffic control devices will be evaluated under Subsections 106.02 and 106.04.

Temporary traffic control services will be evaluated under Subsection 106.02.

Measurement

635.26 Measure temporary traffic control by the lump sum.

Measure the following items for payment when ordered by the (C) and installed:

- (a) Measure advance warning arrow panels by the hour or by the each. When measurement is by the each, measure the panels only one time even if relocated or replaced. When measurement is by the hour, round portions of an hour up to the half hour.
- (b) Measure barricades by the linear foot of width or by the each. Measure only one time even if relocated or replaced.
- (c) Measure cones by the each. Measure only one time even if relocated or replaced.
- (d) Measure construction signs by the square foot of front face sign panel. Do not measure posts and temporary supports. Measure only one time even if relocated or replaced.
- (e) Measure drums by the each. Measure only one time even if relocated or replaced.
- (f) Measure flaggers by the hour, for each hour a person is actually performing the work. Round portions of an hour up to the half hour. Time measured in excess of 40 hours per week will be measured at the same rate as the first 40 hours.
- (g) Measure pilot cars (including operators) by the hour for each hour the car is actually performing the work. Round portions of an hour up to the half hour. Time measured in excess of 40 hours per week will be measured at the same rate as the first 40 hours.
- (h) Measure temporary concrete barriers by the linear foot along the face of the barrier. Measure only one time even if relocated or replaced.
- (i) Measure moving temporary concrete barriers by the linear foot along the face of the barrier as reinstalled at designated locations that are more than 10 feet from the point of initial installation.
- (j) Measure temporary guardrail by the linear foot along the face of the rail from center-to-center of end posts.
- (k) Measure temporary pavement markings by the linear foot, by the mile, by the square foot, or by the each. Measure only one application of pavement markings per lift.

When temporary pavement markings are measured by the linear foot or mile, measure the number of feet or miles of lines applied along the centerline of each 4-inch wide line applied regardless of color. Measure solid lines from end to end of each continuous line. Measure broken lines from end to end including gaps. For line widths greater than 4 inches, adjust the measured length of line in the ratio of the required width to 4 inches.

When temporary pavement markings are measured by the square foot, measure the number of square feet of symbols or letter markings based on the marking area shown in the contract or, if not shown, the area of each marking measured in place to the nearest square foot.

- (l) Measure temporary raised pavement markers by the each. Measure only one time for each lift of pavement even if replaced. Measure temporary raised pavement markers used at the option of the Contractor in lieu of temporary pavement markings as equivalent temporary pavement markings and not as temporary raised pavement markers.
- (m) Measure pavement marking removal by the linear foot of line removed. Gaps will not be measured.
- (n) Measure vertical panels by the each. Measure only one time even if relocated or replaced.
- (o) Measure warning lights by the each. Measure only one time even if relocated or replaced.
- (p) Measure shadow vehicles by the each.
- (q) Measure pavement patches by the ton.
- (r) Measure variable message signs by the each.
- (s) Measure temporary crash cushions by the each for each entire crash configuration. Measure only one time even if relocated or replaced.
- (t) Measure moving temporary crash cushion by the each for each entire crash configuration.

- (u) Measure replacement barrels or cartridges for crash cushions by the each for barrels or cartridges damaged by public traffic.
- (v) Measure temporary traffic signal system by the lump sum or each.
- (w) Measure relocating temporary traffic signal system by the each.
- (x) Measure temporary fence by the linear foot.
- (y) Measure portable rumble strips by the each. Measure only one time even if relocated or replaced.
- (z) Measure opposing traffic lane dividers by the each. Measure only one time even if relocated or replaced.
- (aa) Measure steel plates by the square foot. Measure only one time even if relocated or replaced.

Payment

635.27 The accepted quantities, measured as provided above, will be paid at the contract price per unit of measurement for the pay items listed below that are shown in the bid schedule. Payment will be full compensation for the work prescribed in this Section. See Subsection 109.05.

Progress payments for temporary traffic control devices will be made as follows:

- (a) 50 percent of the unit bid price for each item will be paid upon installation.
- (b) 25 percent of the unit bid price for each item will be paid following completion of 50 percent of the contract amount.
- (c) Payment of the remaining portion of the unit bid price for each item will be paid when the temporary traffic control devices are removed from the project.

Progress payments for items paid for by the hour will be paid at 100 percent of the unit bid price when ordered by the CO and furnished.

Payment will be made under:

Pay Item	Pay Unit
63501 Temporary traffic control	Lump sum
63502 Advance warning arrow panel type ____	Hour
63503 Advance warning arrow panel type ____	Each
63504 Barricade type ____	Linear foot
63505 Barricade type ____	Each
63506 Cone <u>(description)</u>	Each
63507 Construction sign	Square foot
63508 Drum <u>(description)</u>	Each
63509 Flagger	Hour
63510 Pilot car	Hour
63511 Temporary concrete barrier	Linear foot
63512 Moving temporary concrete barrier	Linear foot
63513 Temporary guardrail	Linear foot
63514 Temporary pavement markings	Linear foot
63515 Temporary pavement markings	Minute
63516 Temporary pavement markings, symbols, and letters	Square foot
63517 Temporary pavement markings, symbols, and letters	Each
63518 Temporary raised pavement marker	Each
63519 Pavement marking removal	Linear foot
63520 Vertical panel	Each
63521 Warning light type ____	Each
63522 Shadow vehicle	Each
63523 Maintenance of traffic, pavement patch	Ton
63524 Variable message sign	Each
63525 Temporary crash cushion <u>(description)</u> system	Each
63526 Moving temporary crash cushion	Each
63527 Replacement <u>(description)</u> for crash cushions	Each
63528 Temporary traffic signal system	Lump sum
63529 Temporary traffic signal system	Each
63530 Relocating temporary traffic signal system	Each
63531 Temporary fence <u>(description)</u>	Linear foot
63532 Portable rumble strip	Each
63533 Opposing traffic lane divider	Each
63534 Steel plates	Square foot